Precision Strike

Technology Symposium

"Accelerating Joint & Coalition Technology Advances for Precision Strike"

Laurel, MD

18-20 October 2005

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- ANA Training *(Video)*

Precision Strike Association—Precision Strike Technology Symposium
Accelerating Precision Strike Technology for Stability Operations and Protection of Coalition Forces

October 18-20, 2005

Kossiakoff Conference Center
The Johns Hopkins University/Applied Physics Laboratory, Laurel, MD

David K. Sanders
Deputy PEO for Strike Weapons and Unmanned Aviation

Use of Image-Aided Navigation for UAV & Target Geo-Location in Urban/GPS Denied Environments: ***Dr. Alison K. Brown***—President & CEO of NAVSYS Corp.

Exploiting SAR Imagery at the Sensor: ***David Toms***—Business Development Director, Mercury Computer Systems' Defense Technologies Group

Overview of Third Party Targeting Demonstration Using the APL Precision Target Locator Demonstrator : ***Benjamin A. Huguenin***—Power Projection Systems Dept., JHU/APL

Land Based Target Area of Uncertainty (LBTAOU) Prototype: ***David A. Silvia***—Tactical Tomahawk WCS ACWG, Naval Undersea Warfare Center

FEATURED SPEAKER: ***Honorable Philip E. Coyle, III***
Commissioner, 2005 Base Realignment and Closure Commission & Former Director of Operational Test and Evaluation, OSD

PRECISION ENGAGEMENT—FUTURE OPERATIONS: ***P. Kevin Peppe***
Deputy Director of Phalanx, Raytheon Co.

Joint Concept Technology Demonstration Program (JCTD): ***Mike Knollmann***
ADUSD (Joint & Coalition Operations Support) Advanced Systems & Concepts, OUSD (AT&L)

High Speed Weapons Technology + Networked Weapons: ***Dr. Michael S. Richman***
Associate Director, Aerospace Technology ODUSD (S&T)

Penetrating Effector Systems from EADS/TDW: ***Dr. Helmut F. Muthig***—President & CEO of TDW GmbH

Technology Cooperation—United States Technology Initiatives Abroad:
***Colonel James Dendis, USAF*—**International Cooperation Regional Manager, Int'l Cooperation Directorate, OUSD(AT&L)

Just-In-Time Strike Augmentation: ***Gregory K. Jenkins***—Capability Architect for Capability Integration Directorate, Air Armament Center, Eglin AFB

Military Utility of Synchronized Persistence of C4ISR & Weapons: ***Mark Hall***—Mission Solutions Manager, Precision Engagement Strategic Business Manager, Raytheon Company

Accelerating Networked Sensors and Fires: ***John P. Weinzettle***—Director for Precision Engagement, Raytheon Missile Systems

Realizing the Combat Power of Network Centric Operations: ***CDR John K. Martins, USN***—Member of the Advanced Development Group, FA-18 Program Office

Integrated Precision Strike—Breaking & Redefining Service Boundaries & Levels of Engagement: ***LCDR Theodore T. Ferrazano, USNR***—Joint Operational Test Bed System Assessment Lead,USJFCOM (J-28)

Missile as a Node in the Net Architecture: ***Mark Hal*****—**Mission Solutions Manager, Precision Engagement Strategic Business Area, Raytheon Company

Precision Strike Weapons—The Game has Changed to Dual Mode Guided Bombs: ***Barry Maxwell***—Manager, Paveway Operations and Training, Raytheon Missile Systems

Change in View Point—Application of Dual Recoil Configuration to Light Weight Towed Artillery: ***William T. Zepp***—Senior Artillery Engineer at US Army ARDEC, Picatinny Arsenal

SAASM-ISER—Cost Effective Solution for Verifying SAASM End-to-End Performance on Integrated Weapons Systems: ***Jim Killian*****—**GPS Integration Engineer with 746th Test Squadron, Holloman AFB

Precision and Non-lethal Weapons: ***Steven M. Ritacco*****—**Requirements Center of Excellence Director, Whitney, Bradley & Brown, Inc

Defeating Hard and Deeply Buried Targets: ***Anthony L*****.** ***Pang*****—**Test & Demo PM, HDBT Branch, Technology Development Directorate, Defense Threat Reduction Agency

BLU-122 Warhead Program: ***Maj Mike Lauden*****—**BLU-122 Flight Commander DASG/RU

KEYNOTE ADDRESS: ***Honorable Dale E. Klein***
Assistant to the Secretary of Defense for Nuclear, Chemical & Biological Defense Programs

CORE ADDRESS—COUNTERING THE PROLIFERATION OF WEAPONS OF MASS DESTRUCTION (WMD): ***Dr. James A. Tegnelia*****—**Director, Defense Threat Reduction Agency

SHOW OF ACTIONS—TRAINING THE AFGHAN NATIONAL ARMY:
Brigadier General Thomas P. Mancino, ARNG**—**Assistant Adjutant General of Oklahoma

NAVSYS CORPORATION

Use of Image-aided Navigation for UAV Navigation and Target Geolocation in Urban and GPS-denied Environments

Precision Strike Technology Symposium

Alison K. Brown, Ph.D.

NAVSYS Corporation, Colorado

Phone: 719-481-4877 email: abrown@navsys.com

www.navsys.com

Problem Statement

- Small, low cost UAVs are becoming prevalent on the battlefield
  - E.g. Shadow, Silver Fox, Aerosonde
- Small low cost GPS/inertial navigation solutions are needed
  - Can use MEMs accelerometers and gyroscopes
  - But … MEMs instrument accuracy is 100x worse than tactical IMUs
  - Challenge is to integrate low grade instruments to still provide navigation quality information

Comparison of Inertial Measurement Units

Tactical Grade
Honeywell HG1700 (RLG)

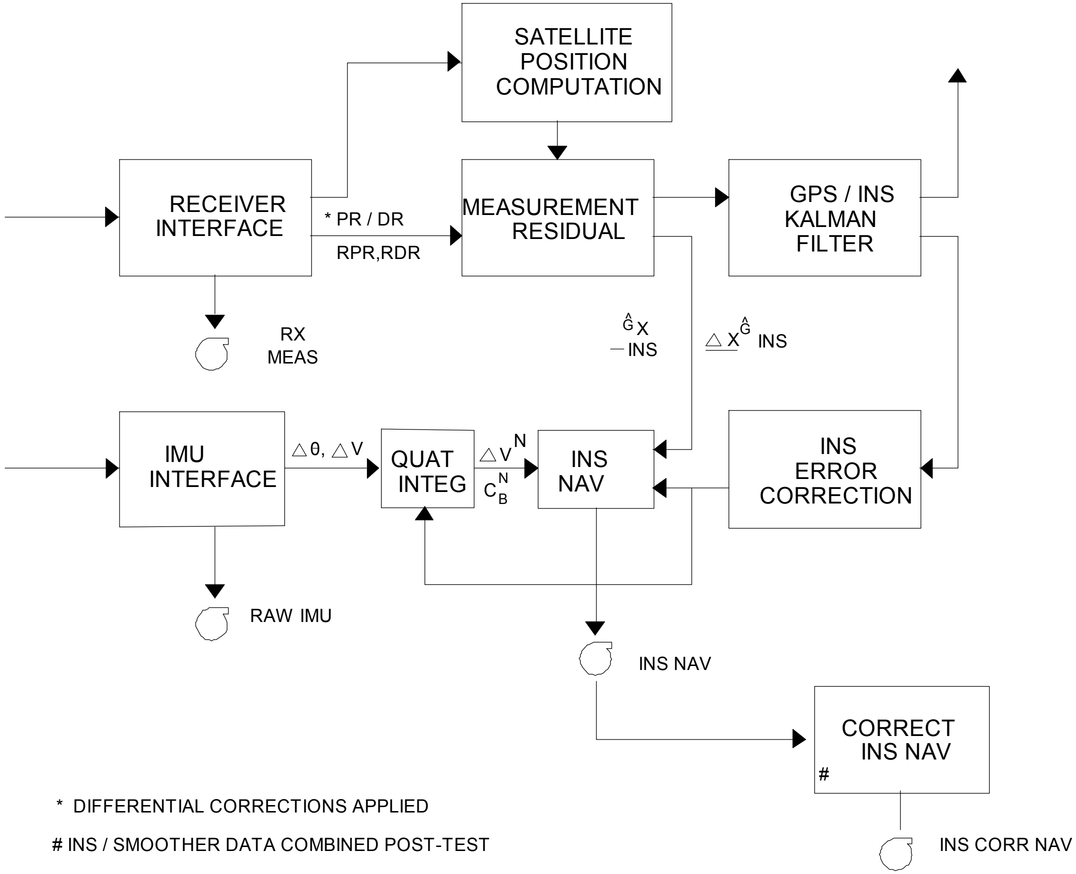
MEMs
Cloud Cap Crista

IMU Gyroscope and Accelerometer Parameter Comparison

Parameters	UNITS	HG1700[i]	Crista[ii]
	Type	*Ring Laser Gyro*	*MEMS*
Size		33 cu in	1.6 cu in
Weight		32 oz	0.7 oz
Power		8 w	0.7 w
Gyroscopes			
Operating Range	±°/s	1000	300
Scale factor accuracy (1 σ)	ppm	150	25000
Scale factor linearity 1 σ to ± 800 °/s	ppm	150	N/A
Bias (1 σ)	°/hour	2	500
Axis alignment stability (1 σ)	µrad	500	3000
Axis alignment stability, non-orthogonality (1 σ)	µrad	100	N/A
Output noise (1 σ of 10,000 samples)	µrad	80	80
Angular random walk max.	°/Rt-hr	0.1	5
Accelerometers			
Operating Range	±g	50	10
Scale factor accuracy (1 σ)	ppm	300	25000
Scale factor linearity (1 σ)	ppm	500	N/A
Bias (1 σ)	mg	1.0	15000
Axis alignment stability (1 σ)	µrad	500	3000
Axis alignment stability, non-orthogonality (1 σ)	µrad	100	N/A
Output noise (1 σ of 10,000 samples)	m/s	0.0024	0.0003[1]
Velocity random walk	(ug/Rt-Hz)	150	450
1. Accelerometer includes filtering in sampled signal			

i HG1700 Specification http://content.honeywell.com/dses/assets/datasheets/ds7_hg1700_imu.pdf
ii Crista IMU Specification http://www.cloudcaptech.com/crista_imu.htm

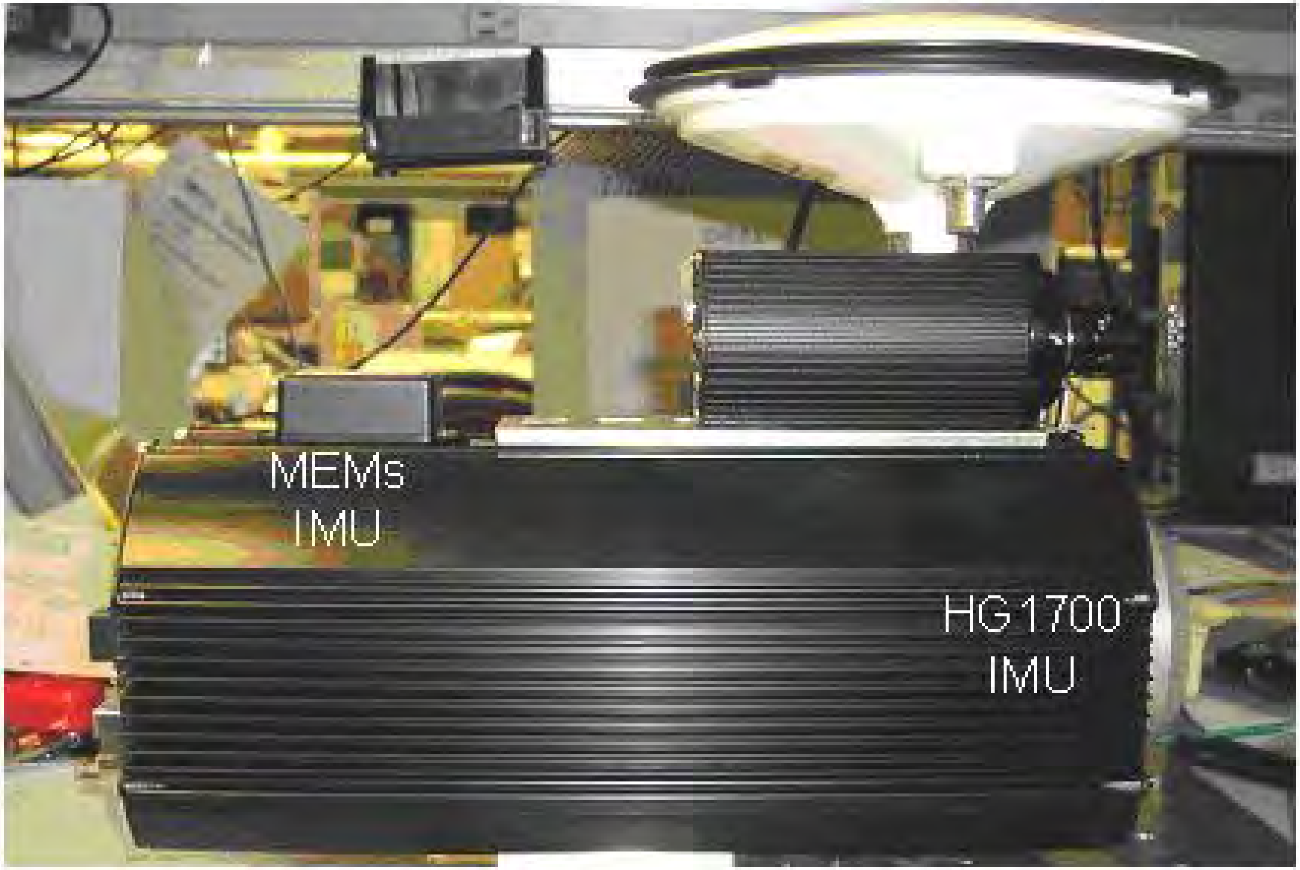
GPS/Inertial Integration using InterNav Kalman Filter allows for IMU Calibration



GPS/INS Correction States
Position Error (navigation frame)
Velocity Error (navigation frame)
Body Attitude Error (navigation frame) (T_x, T_y, α)
Accelerometer bias error
Gyro bias error
GPS Clock bias error
GPS Clock frequency error
Accelerometer misalignment & scale factor error
Gyro misalignment & scale factor error

States allow for calibration of inertial instrument errors

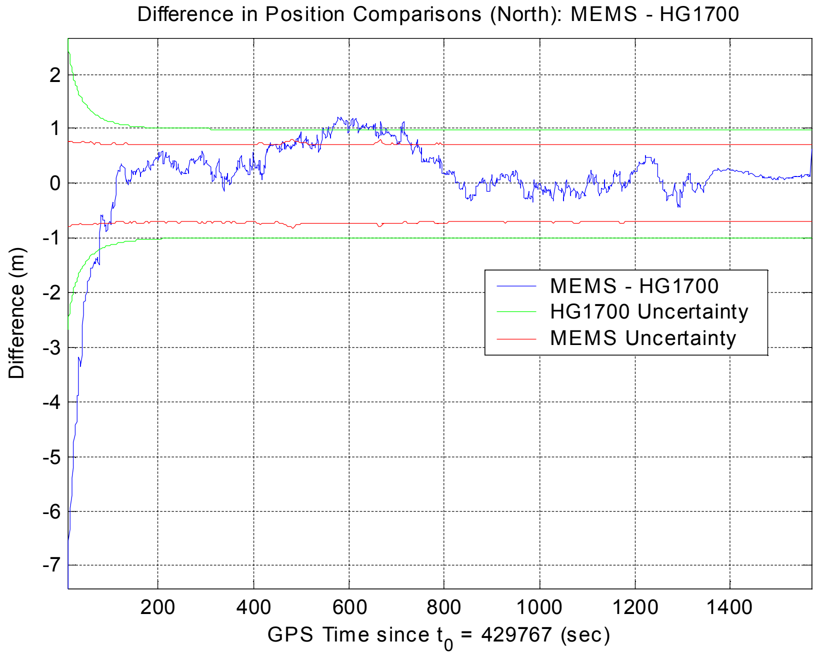
GI-Eye Test Fixture

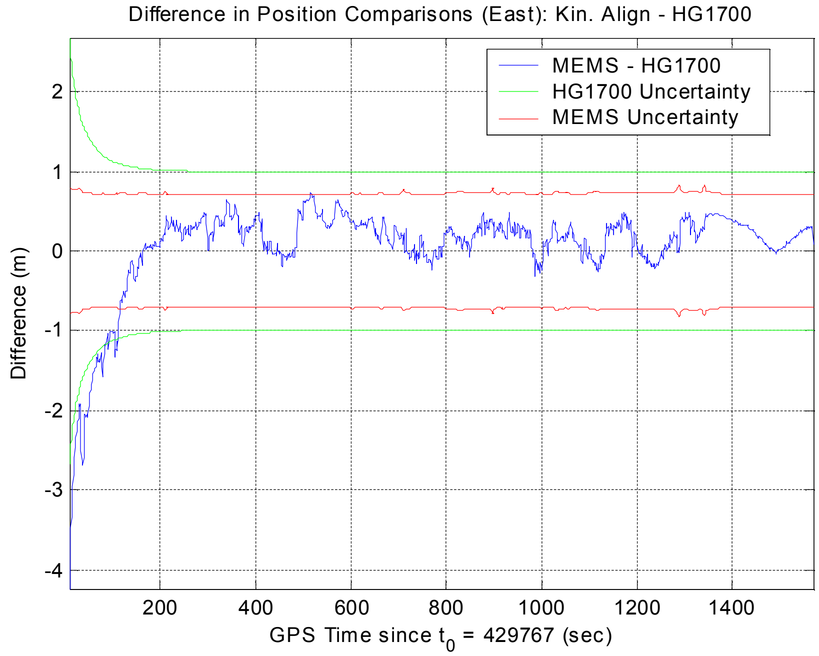


Truck Testing performed to compare HG1700 and MEMs Performance

North position diff HG1700-MEMs

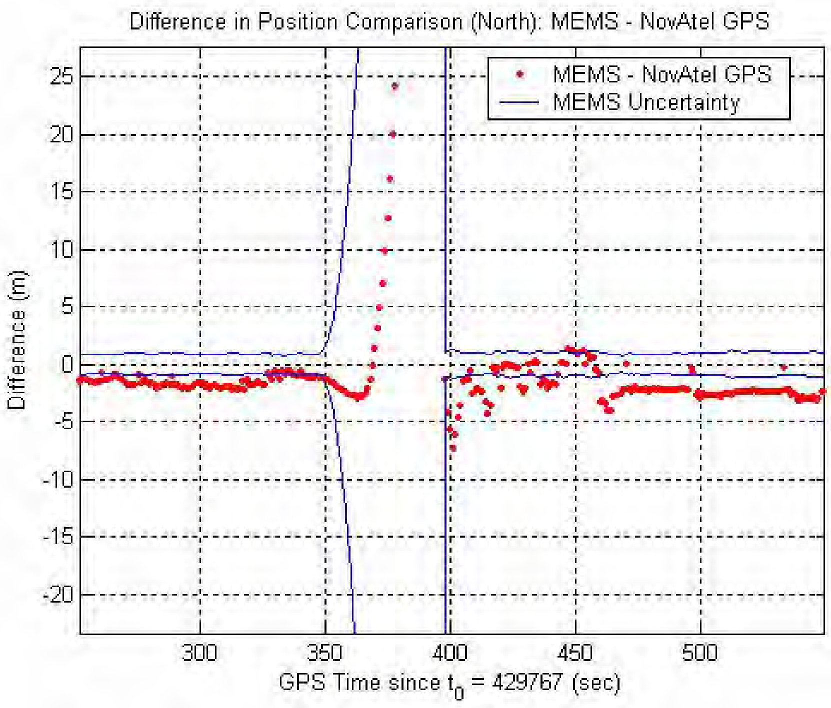
East position diff HG1700-MEMs



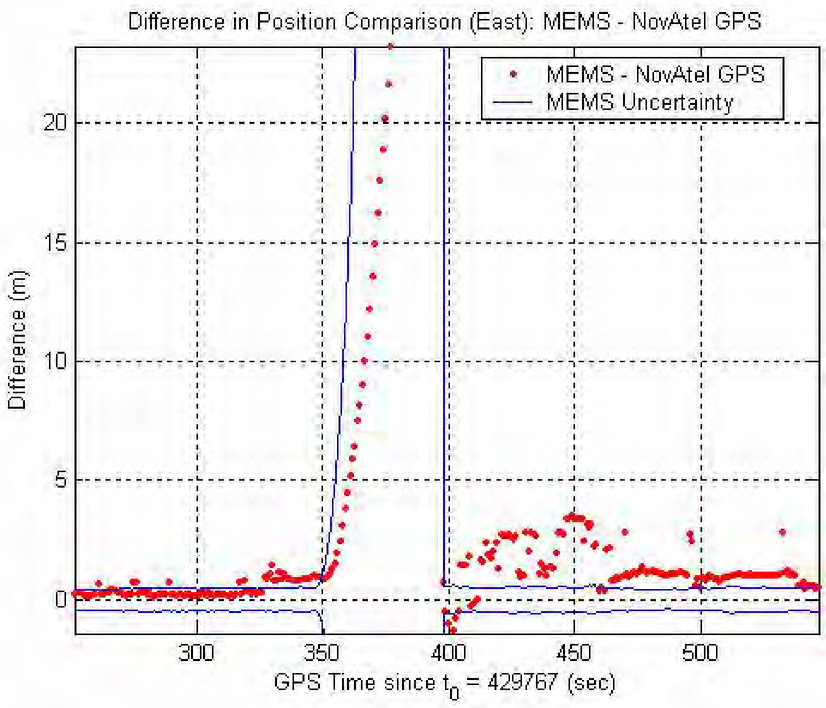


MEMS inertial position errors grow rapidly during GPS drop-out

North Error

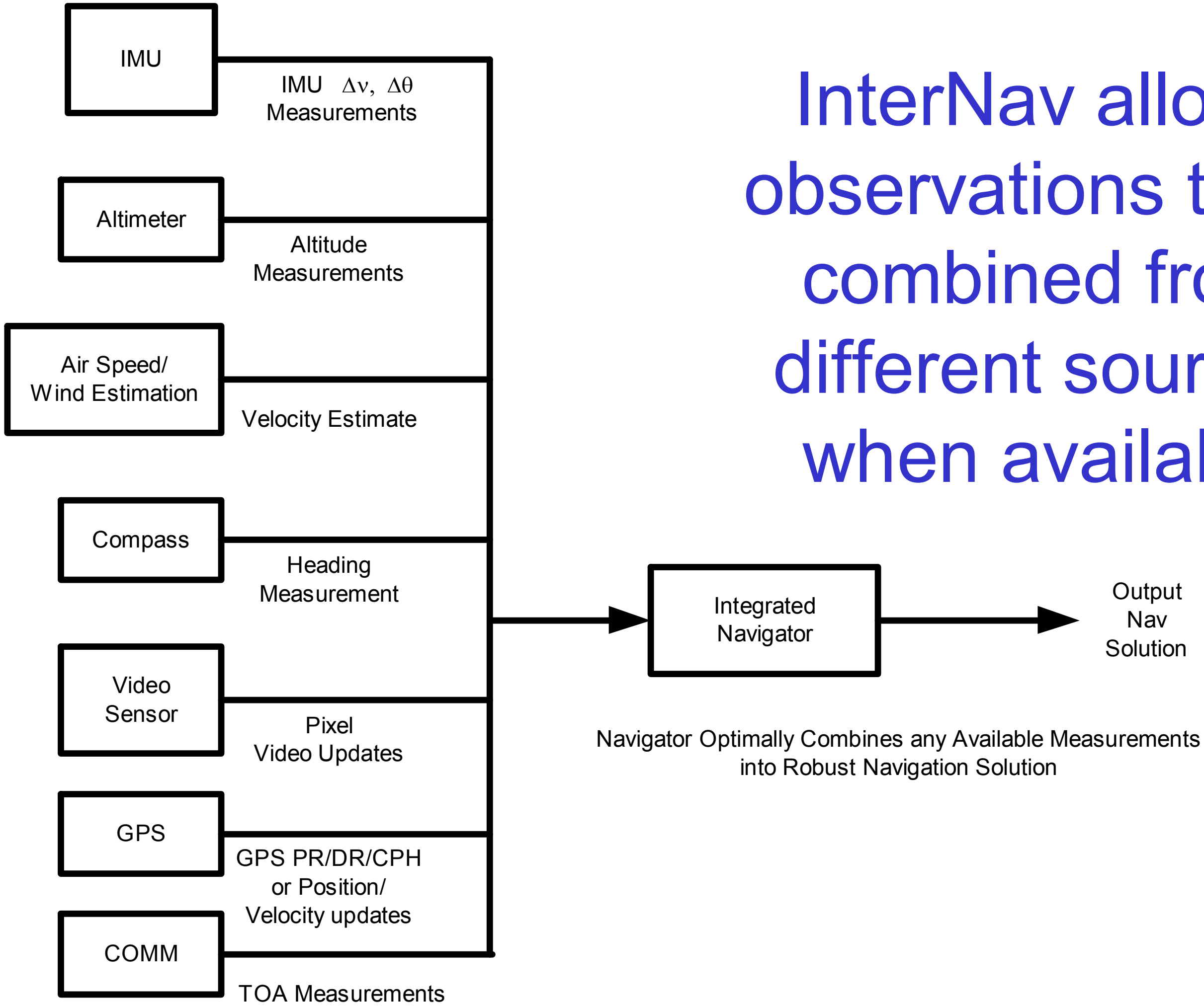


East Error



navsys CORPORATION

Back-Up Inertial Aiding is needed with MEMs IMU during GPS drop-outs

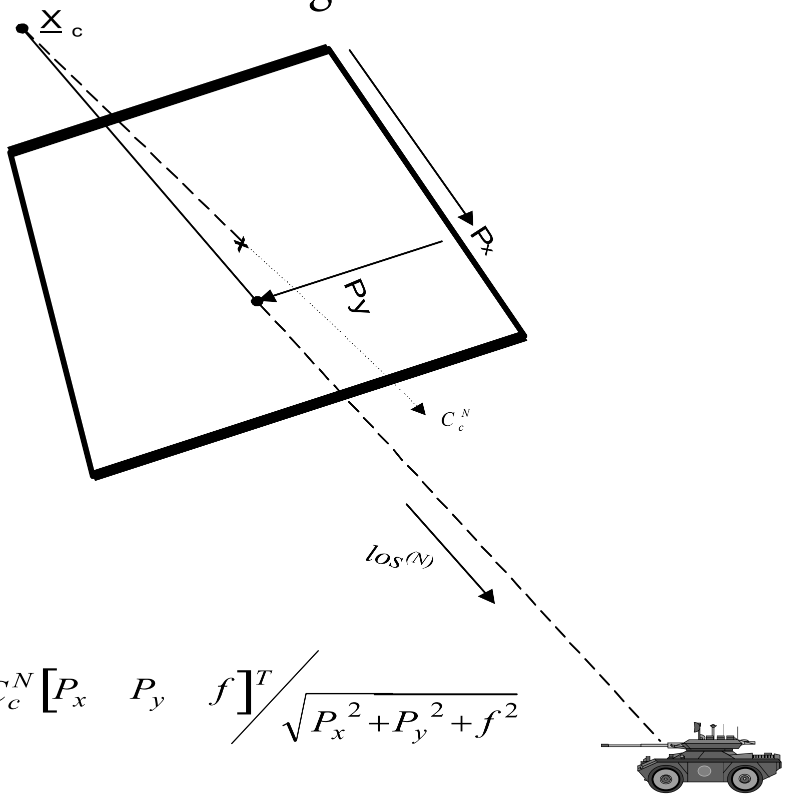


InterNav allows observations to be combined from different sources when available

navsys CORPORATION

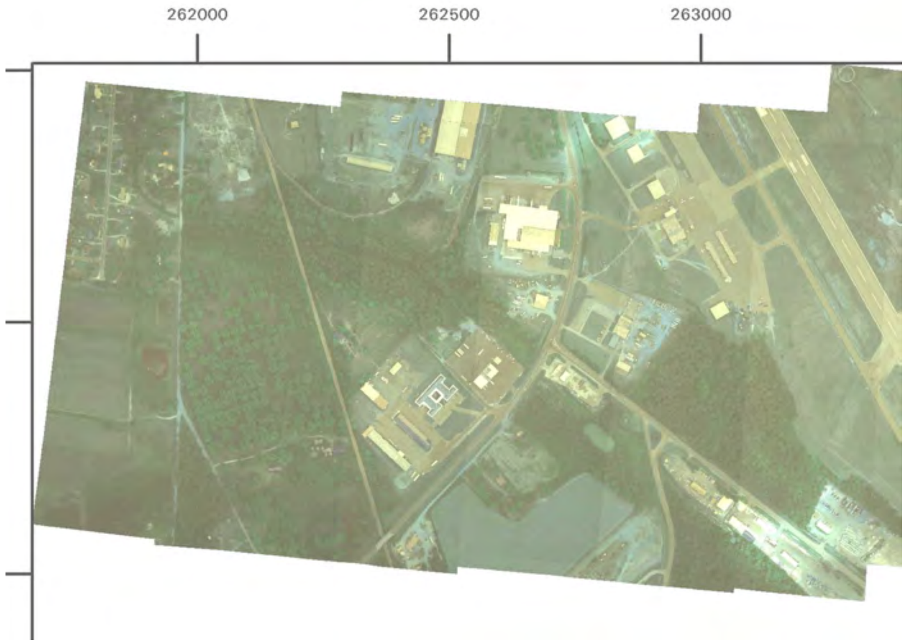
GI-Eye Auto-Georegistration
"Every pixel is a coordinate"

- GI-Eye Payload
  - GPS gives position
  - Inertial gives attitude

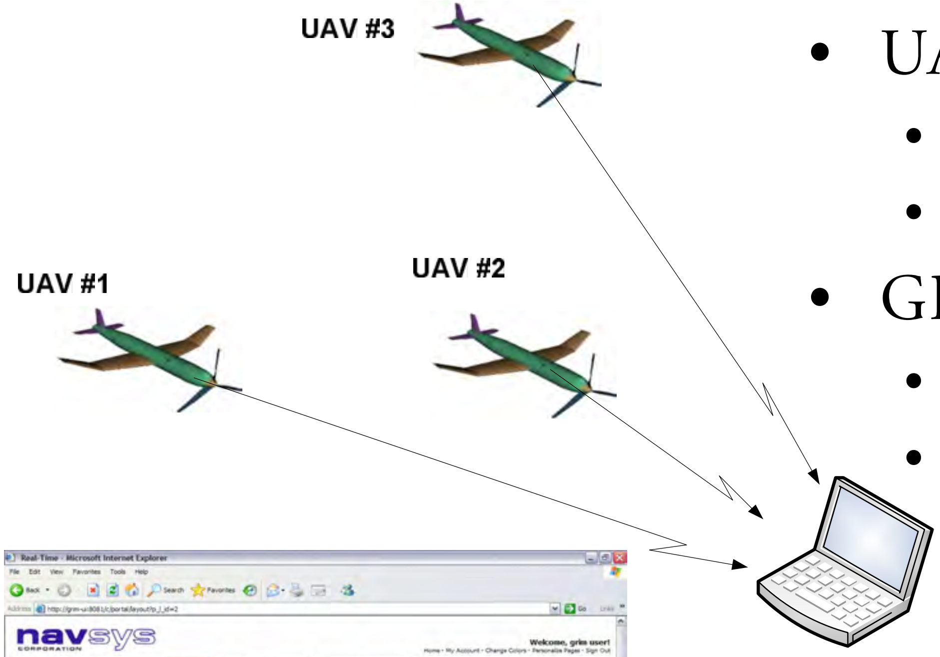


$$los^{(N)} = C_c^N \begin{bmatrix} P_x & P_y & f \end{bmatrix}^T \Big/ \sqrt{P_x^2 + P_y^2 + f^2}$$

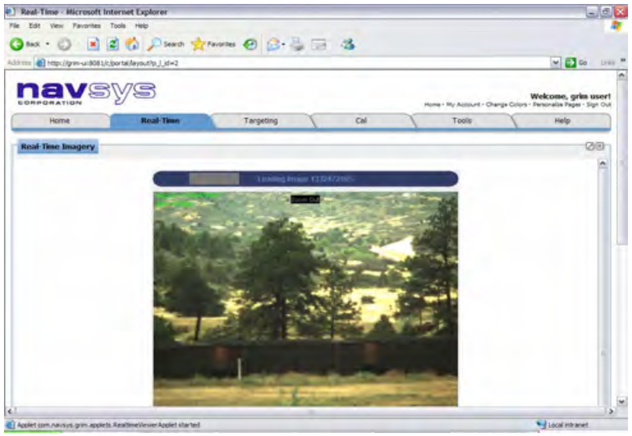
- UAV Sensor Registration
  - Real-time registration for target location
  - Auto-mosaic generation



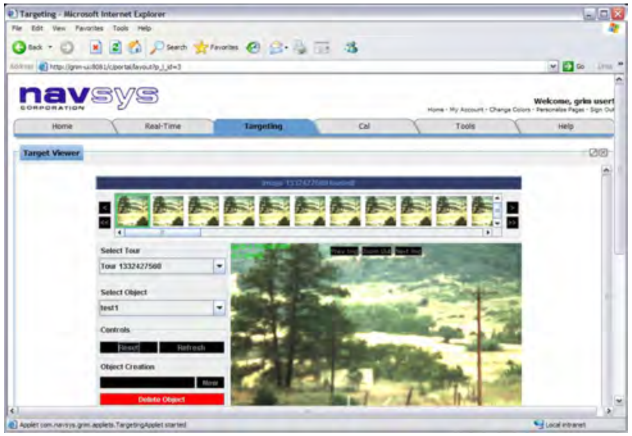
GRIM – Provides access to Sensor data through WLAN and Web Browser



- UAVs with GI-Eye
  - Airborne Server
  - Store Images with MetaData
- GRIM Ground Station
  - Web Browser User Interface
  - Targeting using MetaData



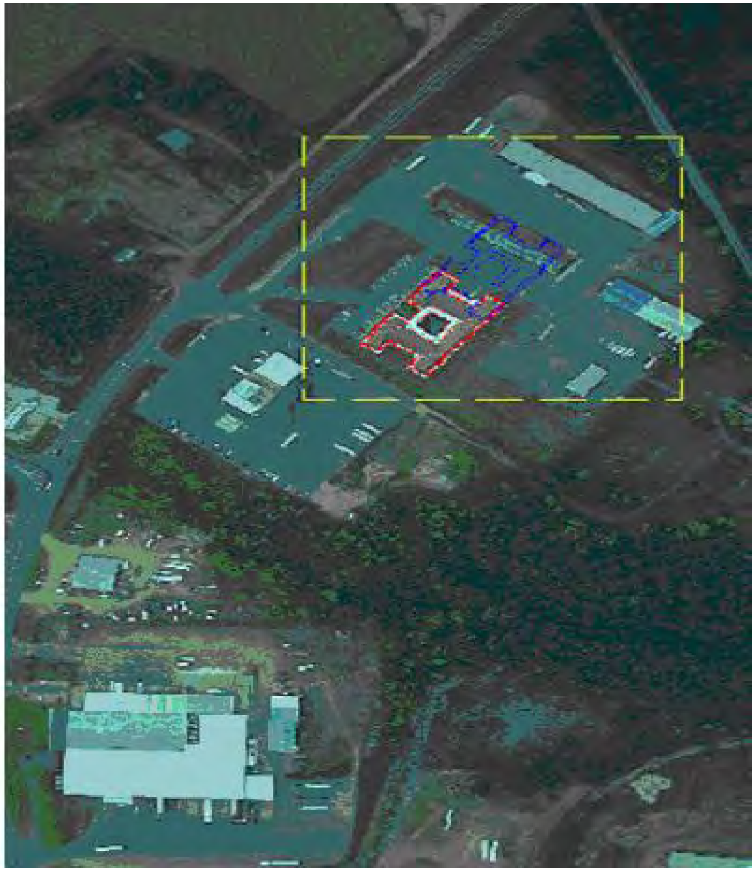
Real Time Viewer



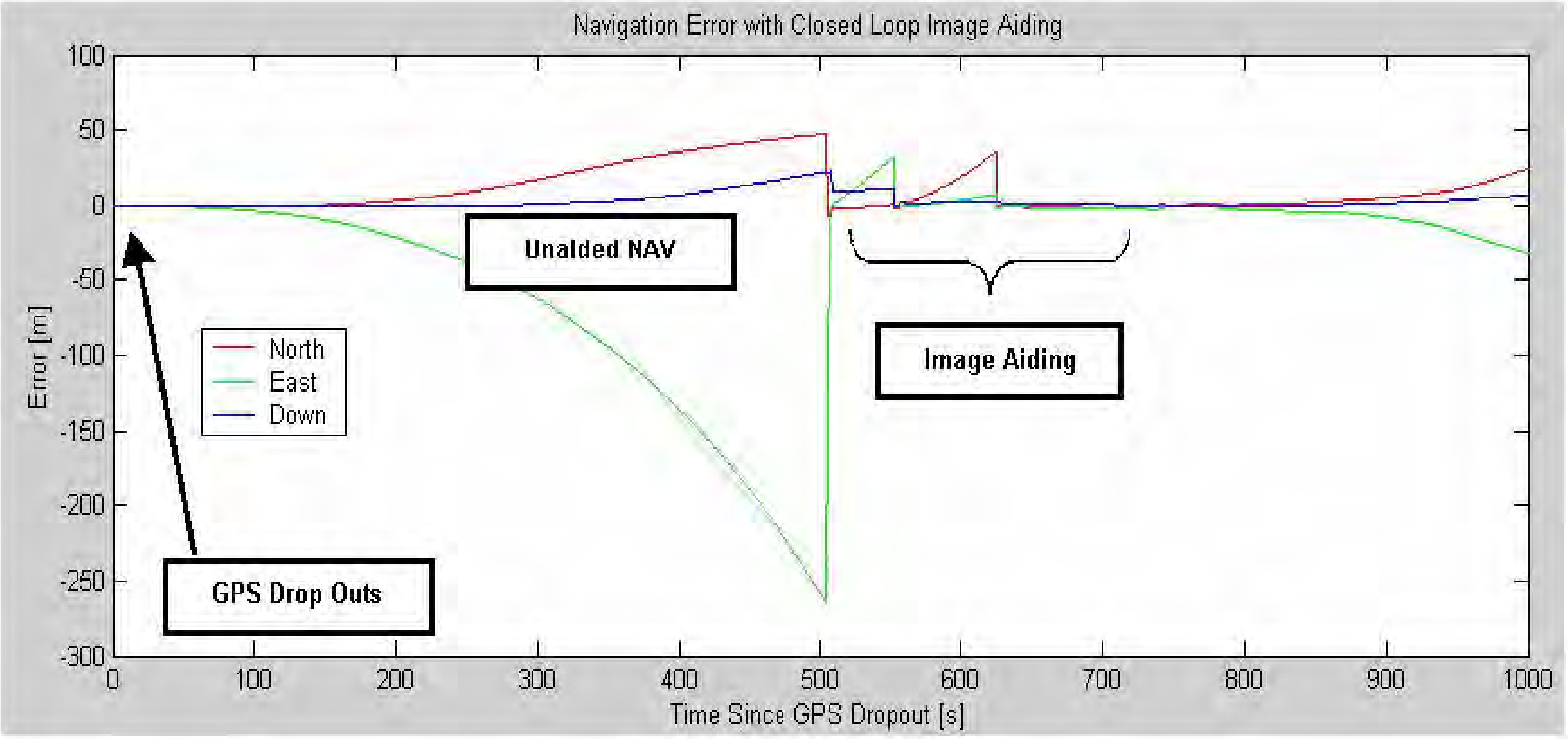
Targeting Page

GRIM Video-inertial Updates

- GRIM Ground Station
  - Used for navigation aiding during GPS drop-outs
- Video updates
  - Model provides reference location
  - Correlation provides pixel centroid location
  - Delta pixel offset expected model location (using inertial soln) observed inertial error
- InterNav on UAV
  - Applies Video Updates from ground station



Airborne Navigation Performance with Image Aiding (Forced GPS drop-outs)



Steady-State Nav Error < 5 m with 2 updates per minute

Conclusion

- A low cost, low grade MEMs IMU can be used as a UAV inertial navigation system
  - Calibration of the MEMs inertial instruments is essential
  - Solution rapidly degrades within minutes without aiding data for GPS or another source
- Applying GPS/Inertial Metadata to Imagery
  - Allows real-time targeting and mosaic generation
  - Allows Video Updates (VUPT) to be applied to UAV using known reference points
  - Inertial VUPT aiding allows robust navigation with low grade MEMs IMUs following GPS drop-outs

The Significance of the 2005 Base Realignment and Closure Outcomes

Now and in the Future

Philip E. Coyle
2005 BRAC Commissioner

Precision Strike Association
Johns Hopkins Applied Physics Laboratory
Laurel, MD
October 18 , 2005

2005 COMMISSIONERS

- The Honorable Anthony J. Principi (Chairman)
- The Honorable James H. Bilbray
- The Honorable Philip E. Coyle, III
- Admiral Harold W. Gehman Jr., USN (Ret)
- The Honorable James V. Hansen
- General James T. Hill, USA (Ret)
- General Lloyd W. Newton, USAF (Ret)
- The Honorable Samuel K. Skinner
- Brigadier General Sue E. Turner, USAF (Ret)

COMMISSION POLICIES

- Commissioner visited every installation recommended for a major closure or realignment action (-300 or more civilians)
- Every affected community had a chance to be heard
- Regional hearings provided communities a forum
- All Commission documentation made available to public
- All Commission activities open to the press and the public

2005 COMMISSION PROCESS

- May 13 - Receive DoD report
- Throughout process - Investigative hearings
- May through July - Base visits/regional hearings
- July 1 - GAO report
- July 19 - Adds/substitutions hearing
- July and August - Adds base visits / regional hearings
- August 24-27 - Final deliberation hearings
- September 8 - Report to the President

COMMUNITY INTERACTION

- Held 20 regional hearings around the Nation and 20 exploratory hearings.
- Commission received over 300,000 pieces of written correspondence
- Website (www.brac.gov) received over 25 million hits
- Over 13,000 public comments were posted to the website

The BRAC 2005 Strategic Context

- The first BRAC to be conducted in a decade
- The first to be conducted during a time when the United States military is heavily involved overseas in sustained battle.
- The first when defense spending was consistently increasing. During past BRAC rounds, defense spending was going down or scheduled to go down.
- The first since 9/11 and the first in the post-9/11 security environment.
- The first to be conducted under a National Defense Strategy and Quadrennial Defense Review that de-emphasizes conventional war fighting and emphasizes unconventional or asymmetric war fighting.

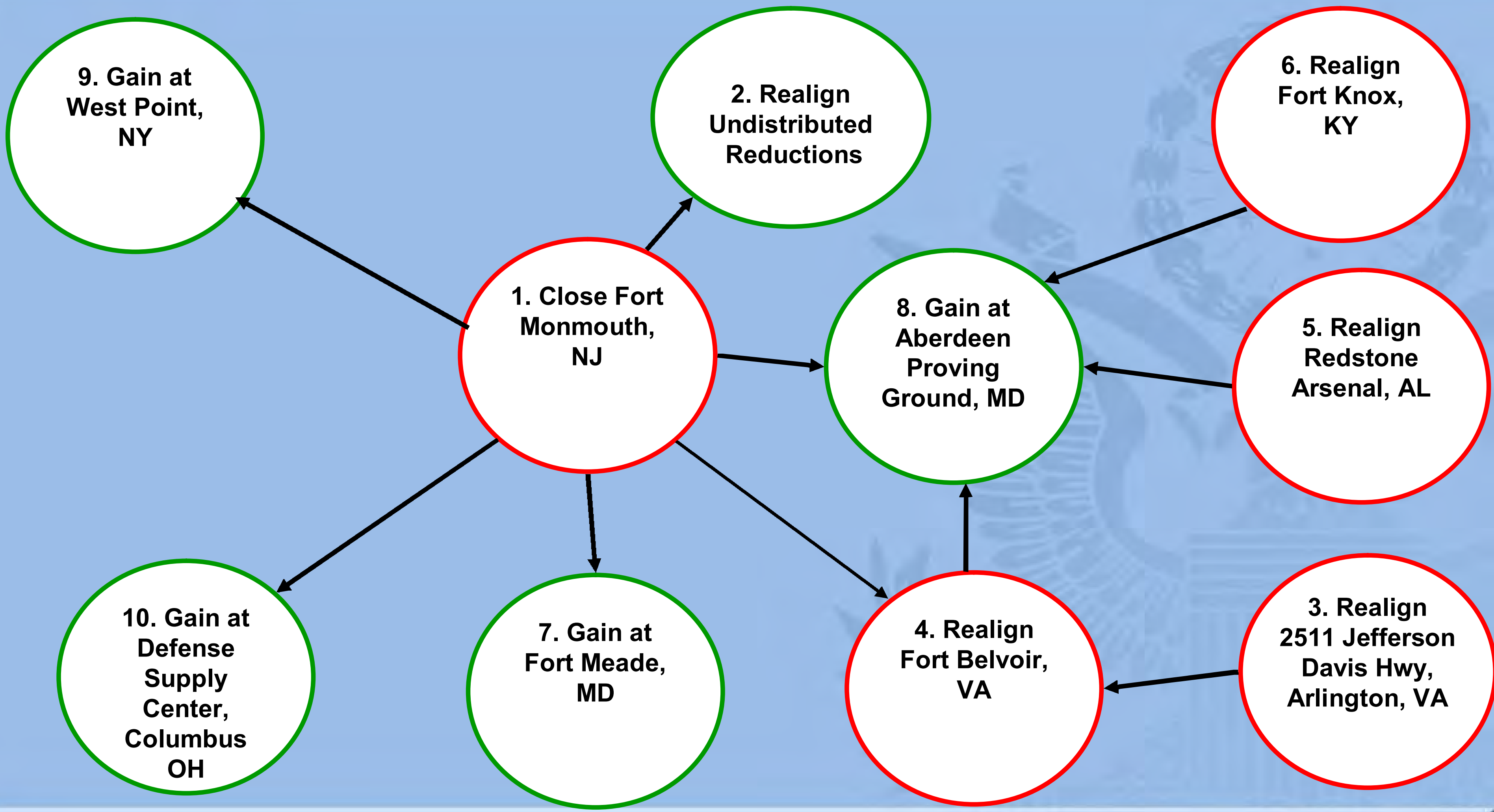
Initial Observations

- The 2005 BRAC was the largest and most complex BRAC in history.
- And produced the largest savings of any BRAC.
- The low and medium hanging fruit has been picked.
- DOD proposals that cost money were buried in larger DOD proposals that saved money.
- Larger bases got bigger; smaller installations were absorbed.

The DOD Proposals were characteristic of the Rumsfeld Pentagon

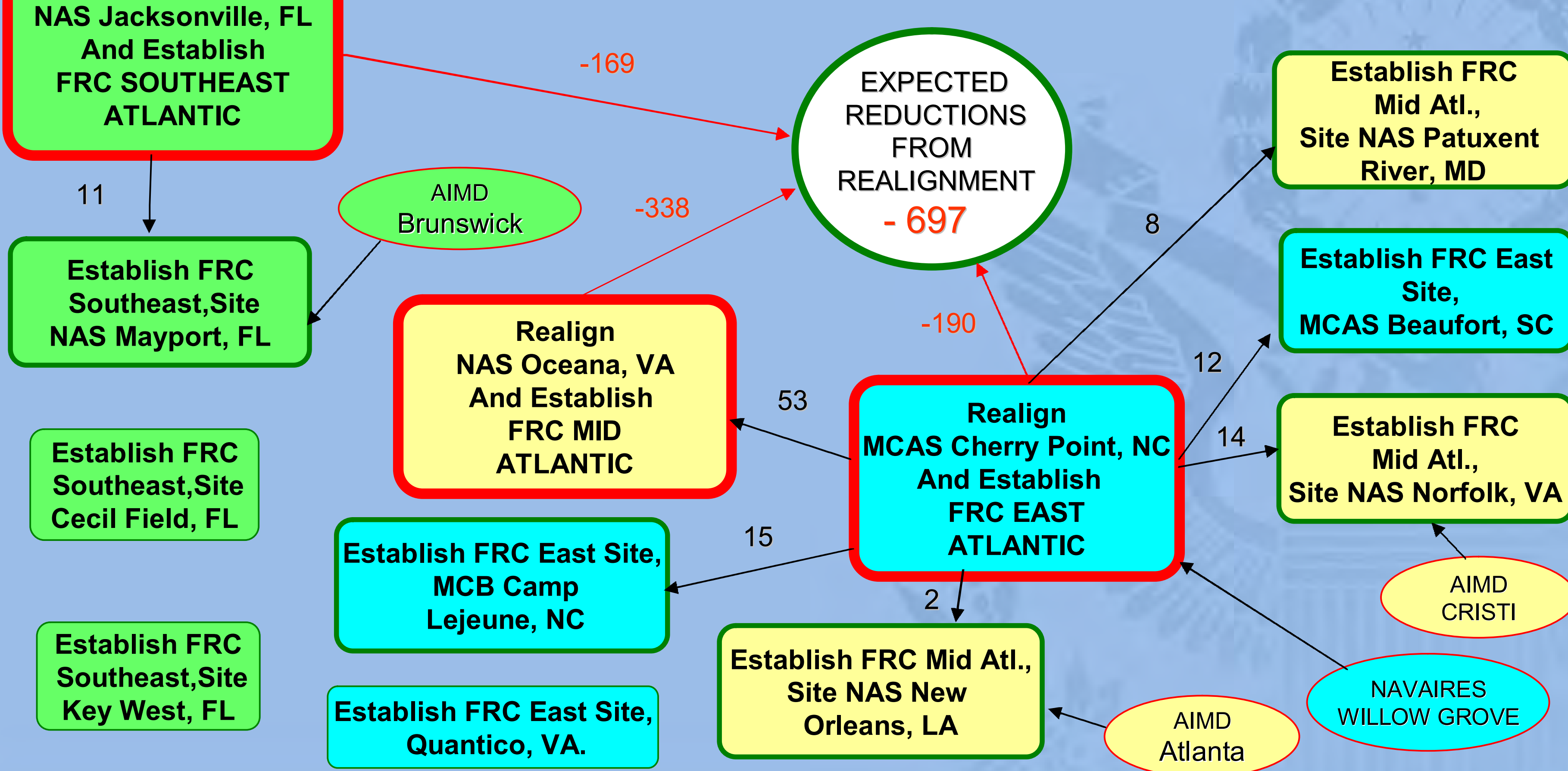
- Aggressive
- Far-reaching
- Complex
- Innovative

Section 5: Close Fort Monmouth - NJ Associated Installations



SEC. 165: Reorganization of Naval Air Intermediate and Depot maintenance Into Fleet Readiness Centers. (East Coast)

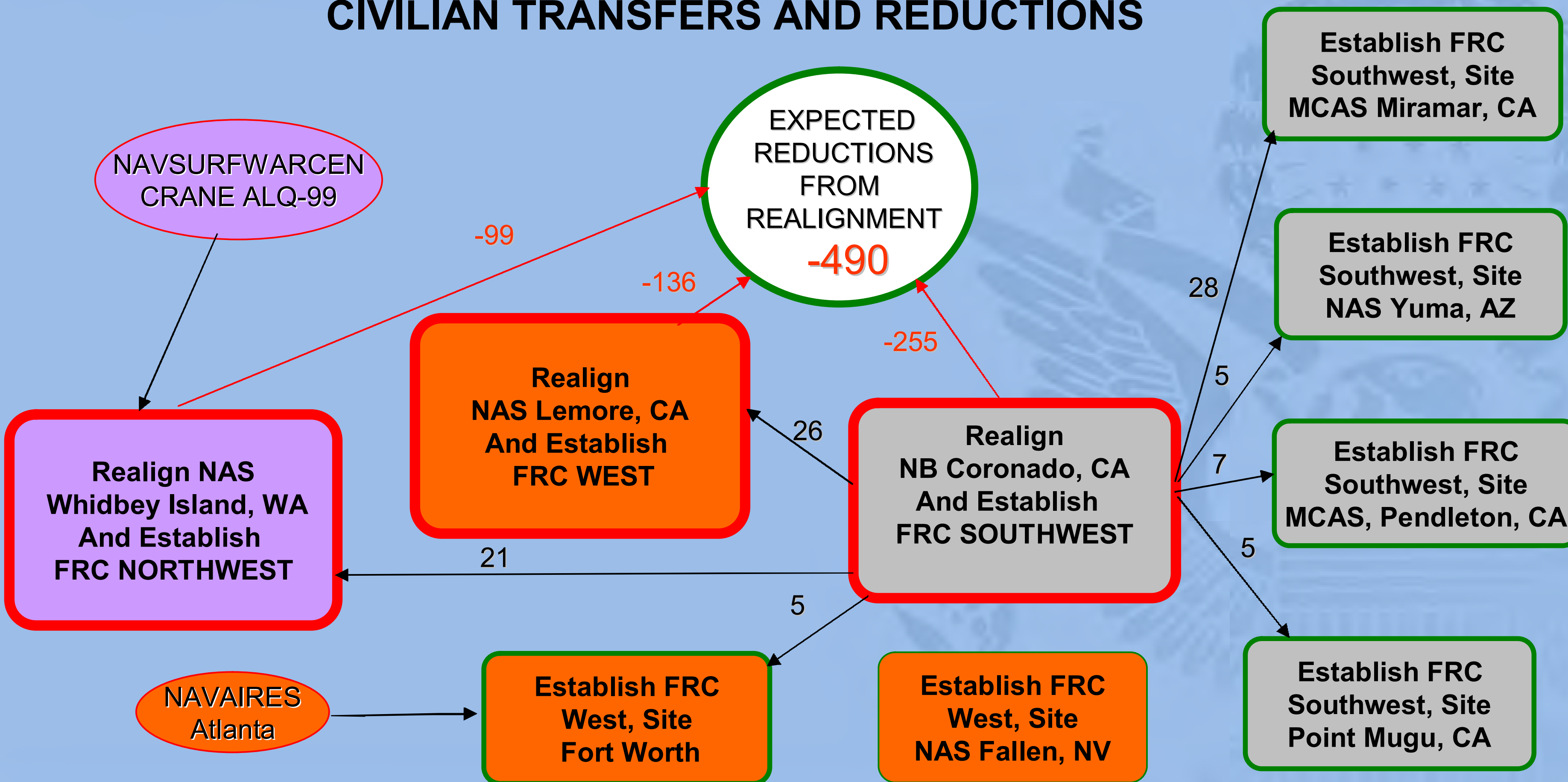
REDISTRIBUTION OF WORKLOAD AND EXPECTED CIVILIAN TRANSFERS AND REDUCTIONS



SEC. 165: Reorganization of Naval Air Intermediate and Depot maintenance Into Fleet Readiness Centers.

(West Coast)

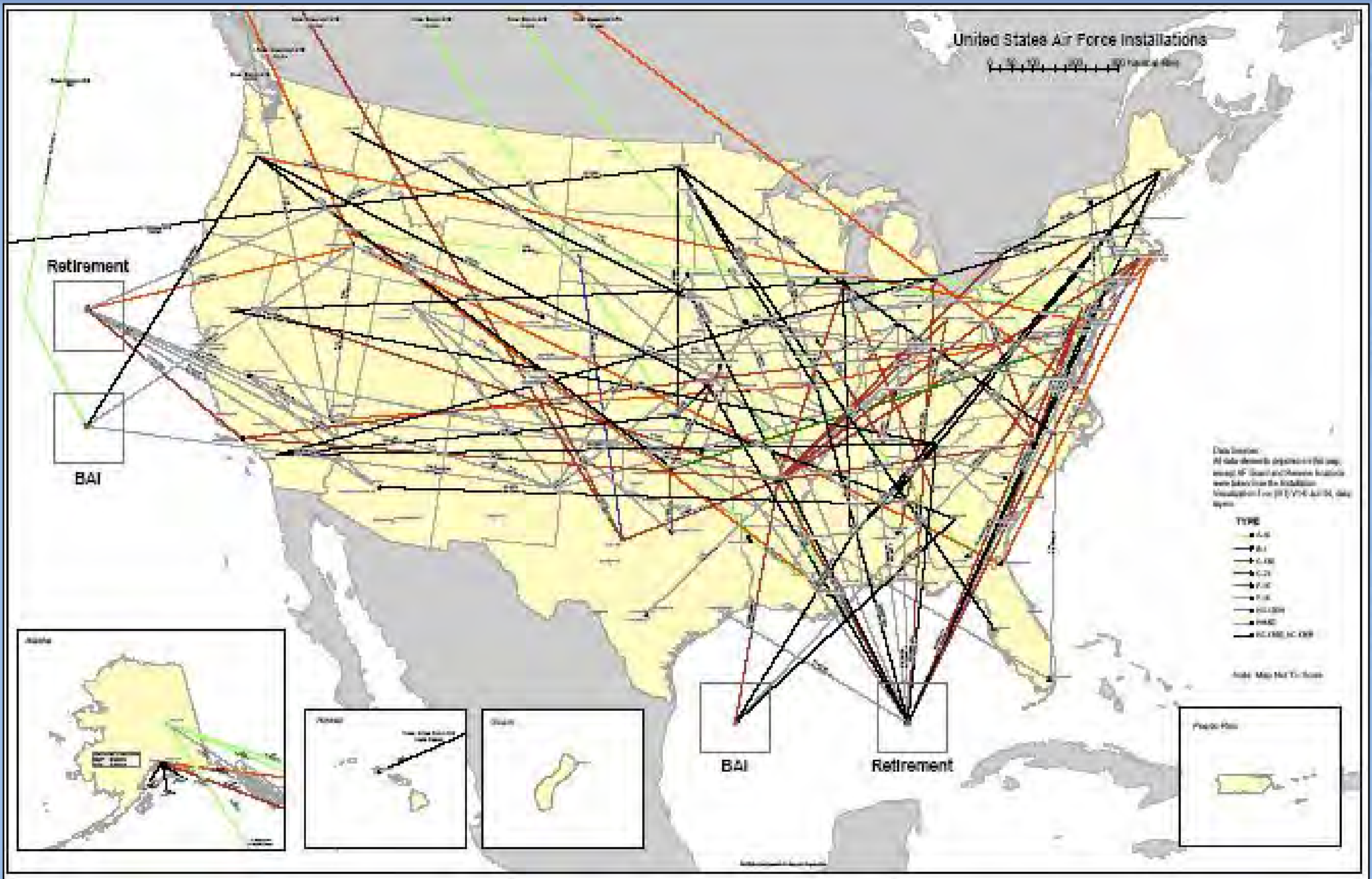
REDISTRIBUTION OF WORKLOAD AND EXPECTED CIVILIAN TRANSFERS AND REDUCTIONS



DOD Deficiencies

- A lack of Jointness
- A lack of transformation, hidden costs, and misleading savings
- Access to DOD Justifications and Back-up Data
- Timing relative to the QDR and Overseas Basing Commission
- Coordination with States and other government agencies, especially DHS.
- Complex, intertwined recommendations of seemingly unrelated actions.

Air Force "Cat's Cradle"



AIR NATIONAL GUARD ISSUES

- DoD recommendations driven by the reduction in aircraft inventory; need to man emerging missions; and desired optimal squadron sizes
- States concern was need of Air National Guard resources to perform state missions, such as homeland security and disaster relief
- Commission lay-down balanced DoD goals and state interests:
  - Established aircraft at nine Air National Guard installations that would have been left without aircraft by DoD recommendations
  - Reinstituted Air National Guard flying missions in three states that would have lost those missions in the DoD recommendations
  - Allowed for better support of recruiting and state mission needs
  - Realigned some flying missions Permanently based air intercept aircraft in a parts of the Country

2005 BRAC Recommendations Breakout by Service

Service Group	*Recommendation (Bill Section Number)*	*Total Recommendations*	*Total Actions (Close or Realign)*
Commission Representation of OSD Recommendations			
Army	**1 – 56**	**56**	**222**
Navy	**57 – 77**	**21**	**59**
Joint Cross Service	**120 – 190**	**71**	**381**
Air Force	**78 - 119**	**42**	**78**
OSD Totals		**190**	**740**
ADDS	**5**	**5**	**8**
Totals		**195**	**748**

Comparison of BRAC 2005 with Previous Rounds (From GAO Report)

Round	*Major Closures*	*Major Realignments*	*Minor closures and realignments*	*Total actions*
1988	16	4	12	43
1991	26	17	32	75
1993	28	12	123	163
1995	27	22	57	106
Total Previous Rounds	97	55	235	387
Total 2005	22	33	685	740

Commission
Cost and Savings Comparison

Round	Costs*	Net Annual Recurring Savings *	20-Year Net Present Value Savings*
1988	$2.8	$0.9	$8.5
1991	$5.2	$2.0	$22.6
1993	$7.6	$2.6	$26.3
1995	$6.8	$1.7	$16.6
Total Previous Rounds	$22.4	$7.2	$73.9
Total 2005	$21.0	$4.2	$35.6

*Dollars in billions

2005 COBRA Data Update

Cost / (Savings) Summary		
	Commission	DoD Baseline without Military Personnel Savings
One Time Cost	$ 21.0	$ 21.0
Net Implementation Cost	$ 4.5	$??
20-Year Net Present Value (Savings)	($ 35.6)	($ 15.1)

**Dollars in billions*

THE JOINT CROSS-SERVICE GROUP TEAM

The Joint Cross Service Team team supported direct analysis of those recommendations submitted by the SECDEF Joint Cross Service Sub-Groups

1. Education and Training
2. HQ and Support Activities
3. Industrial
4. Intelligence
5. Medical
6. Supply and Storage
7. Technical

JOINT BASING

McChord AFB/Fort Lewis, Washington

Fort Dix/NAES Lakehurst/McGuire AFB, New Jersey

Joint Base Andrews AFB/Naval Air Facility - Washington, MD.

Joint Base Anacostia-Bolling - D.C. (Bolling AFB+ Naval District of Washington)

Joint Base Myer-Henderson Hall, Virginia

Joint Base Elmendorf-Richardson, Alaska

Joint Base Pearl Harbor-Hickam, Hawaii

Installation Management Functions from Fort Sam Houston and Randolph AFB to Lackland AFB, Texas

Installation Management Functions from Naval Weapons Station Charleston to Charleston, AFB, South Carolina

Installation Management Functions from Fort Eustis to Langley AFB, Virginia

Installation Management Functions from Fort Story to Commander Naval Mid-Atlantic Region, Naval Station Norfolk, Virginia

Installation Management Functions from Andersen AFB to Commander US Naval Forces, Marianas Islands, Guam

CENTERS OF EXCELLENCE

Air and Space C4ISR Research, Development, Acquisition, Test and Evaluation (#179)

Maritime C4ISR Research, Development, Acquisition, Test and Evaluation (#181)

Naval Integrated Weapons & Armaments Research, Development, Acquisition, Test and Evaluation (#184)

Air Integrated Weapons & Armaments Research, Development, Acquisition, Test and Evaluation (#185)

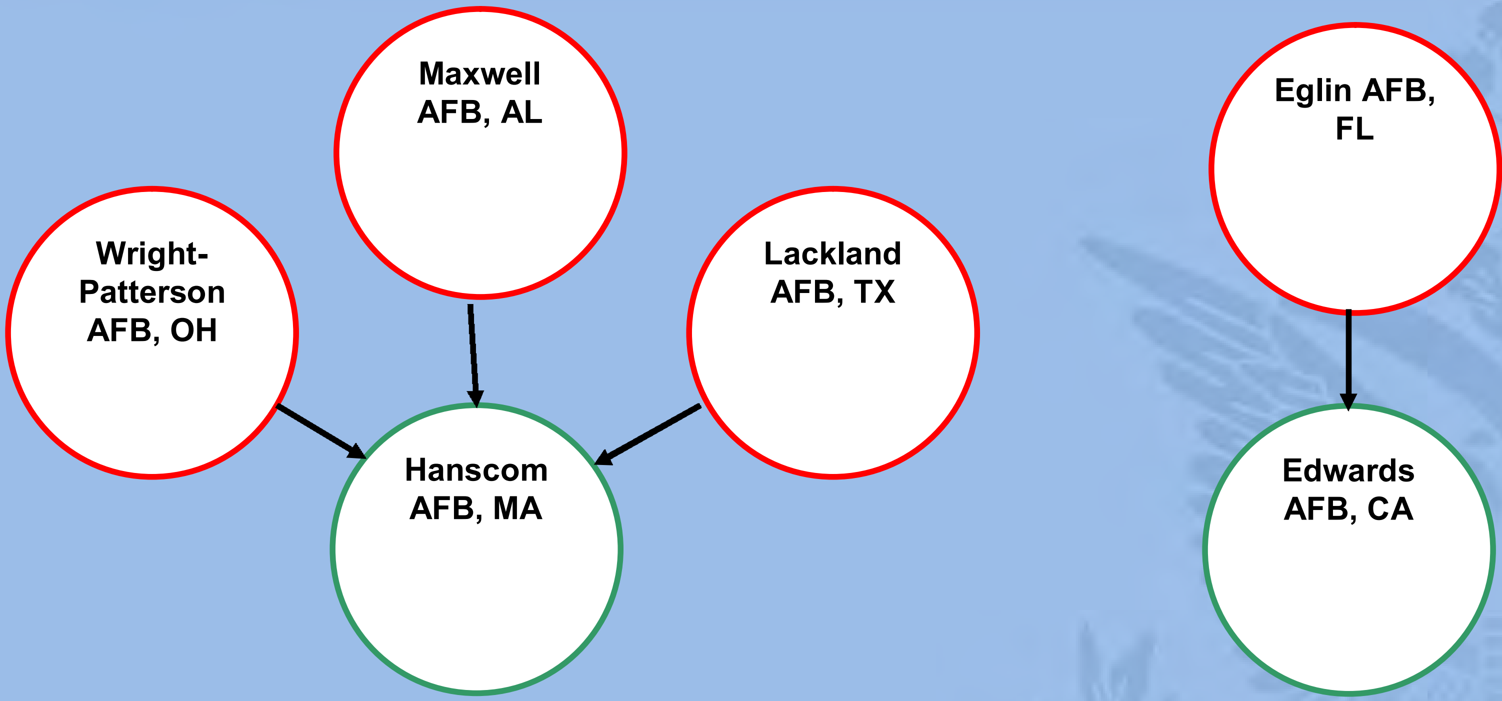
Integrated Weapons and Armaments Site for Guns and Ammunition (#186)

Fixed Wing Air Platform Research, Development, Acquisition, Test and Evaluation (#188)

Rotary Wing Air Platform Research, Development, Acquisition, Test and Evaluation (#189)

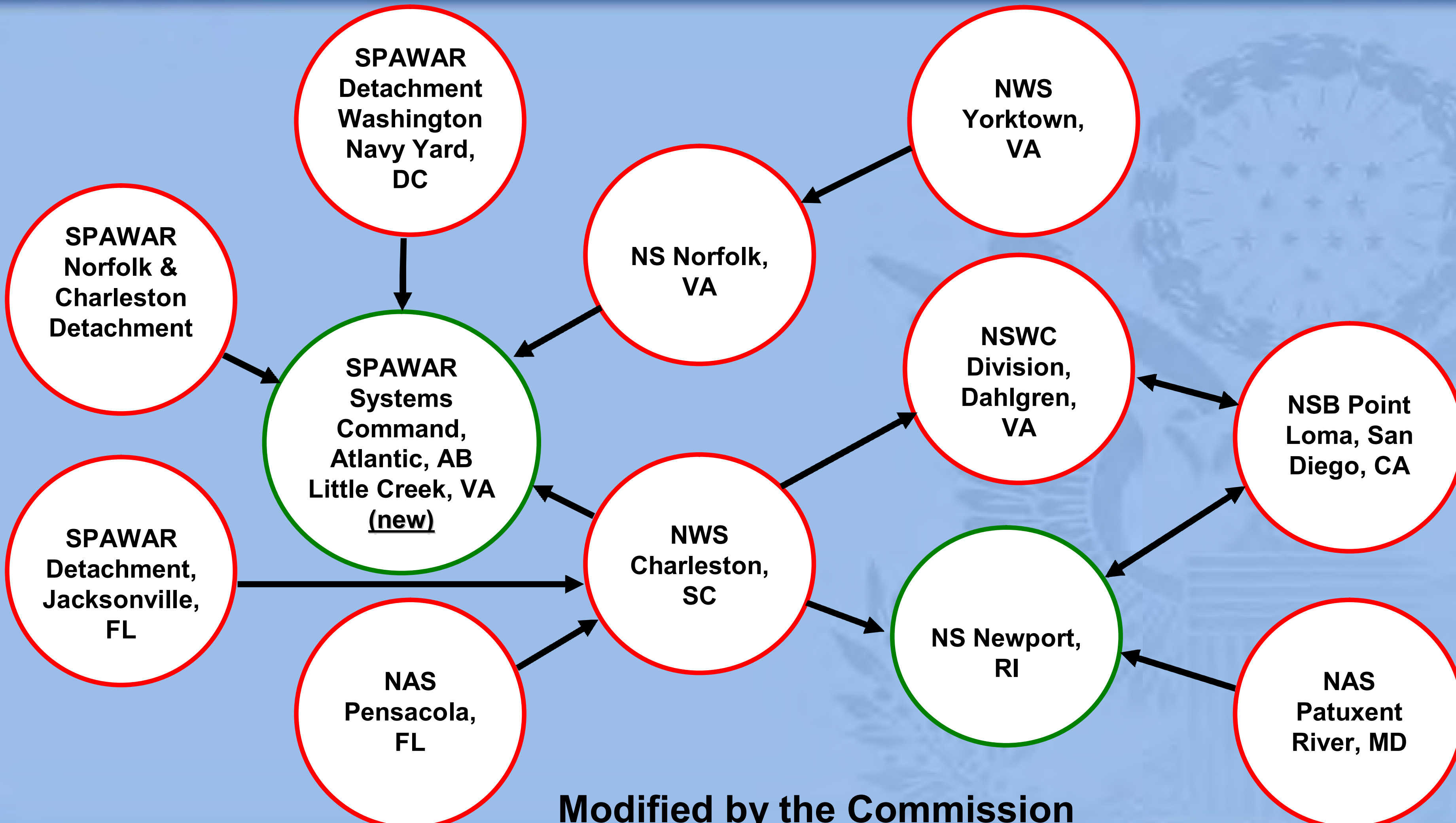
Navy Sensors, Electronic Warfare, and Electronics Research, Development, Acquisition, Test and Evaluation (#190)

Sec. 179: Air and Space C4ISR Research, Development & Acquisition, Test & Evaluation



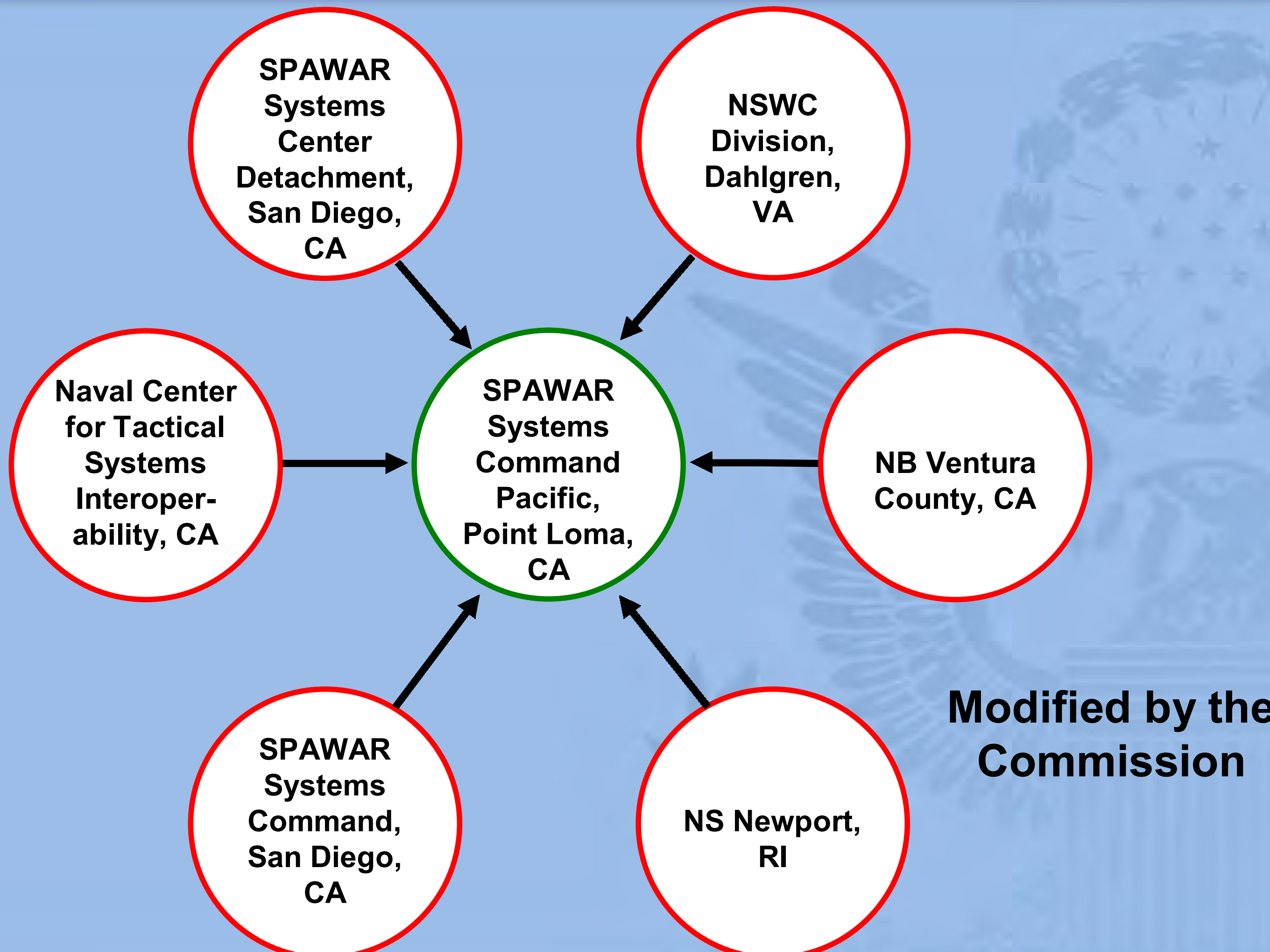
Rejected by the Commission

Sec. 181: Consolidate Maritime C4ISR Research, Development & Acquisition, Test & Evaluation

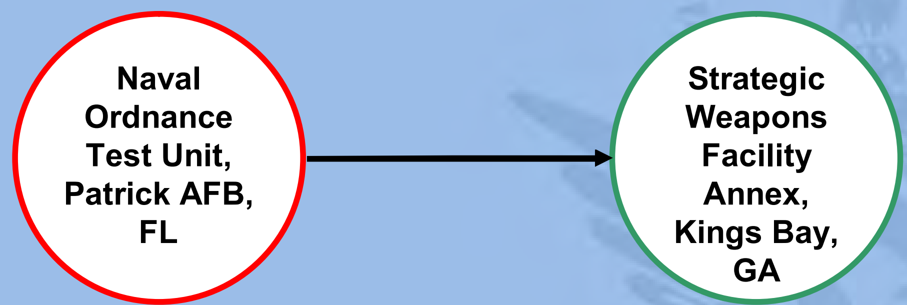


Modified by the Commission

Sec. 181: Consolidate Maritime C4ISR Research, Development & Acquisition, Test & Evaluation

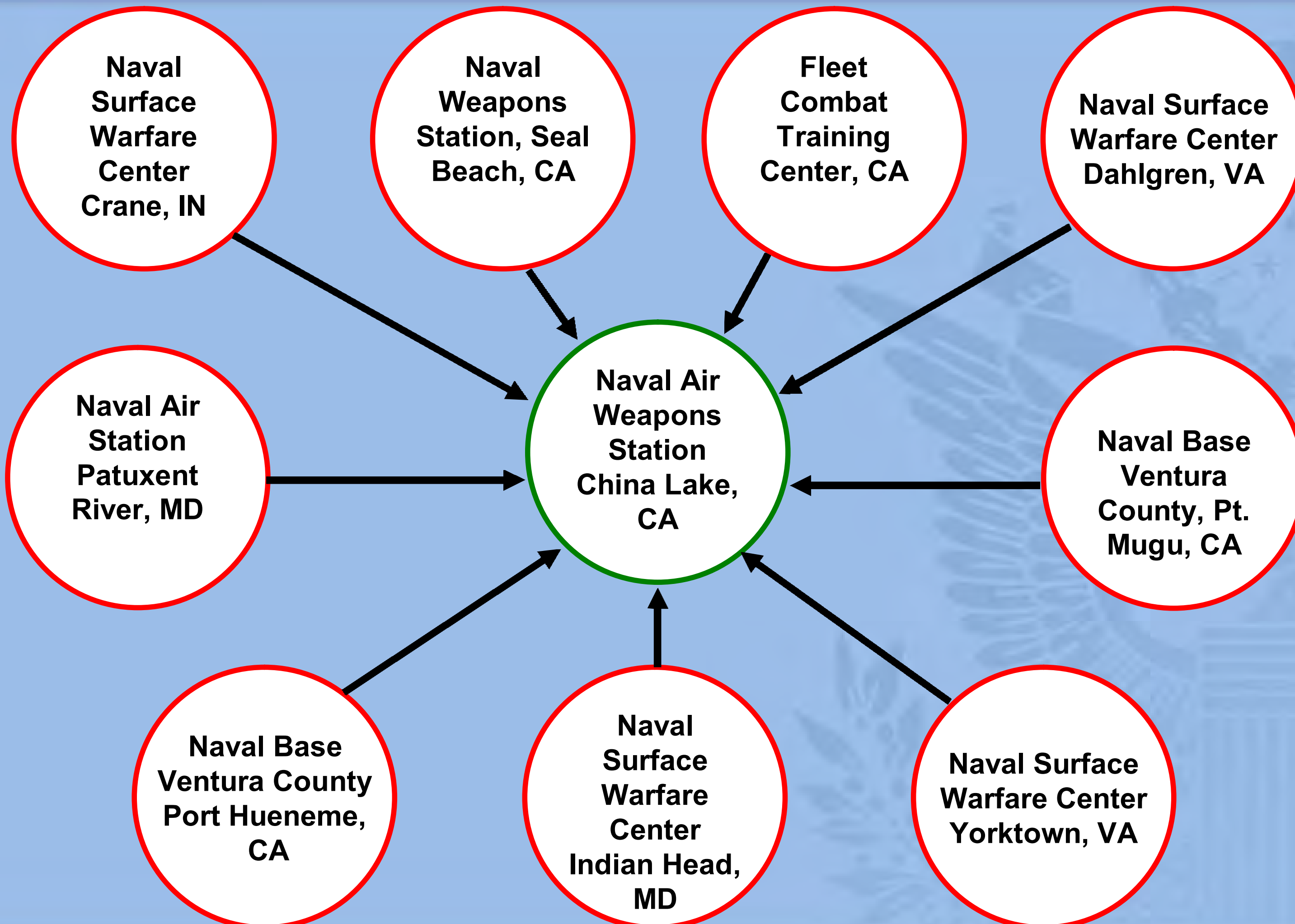


Sec. 182: Consolidate Navy Strategic Test & Evaluation



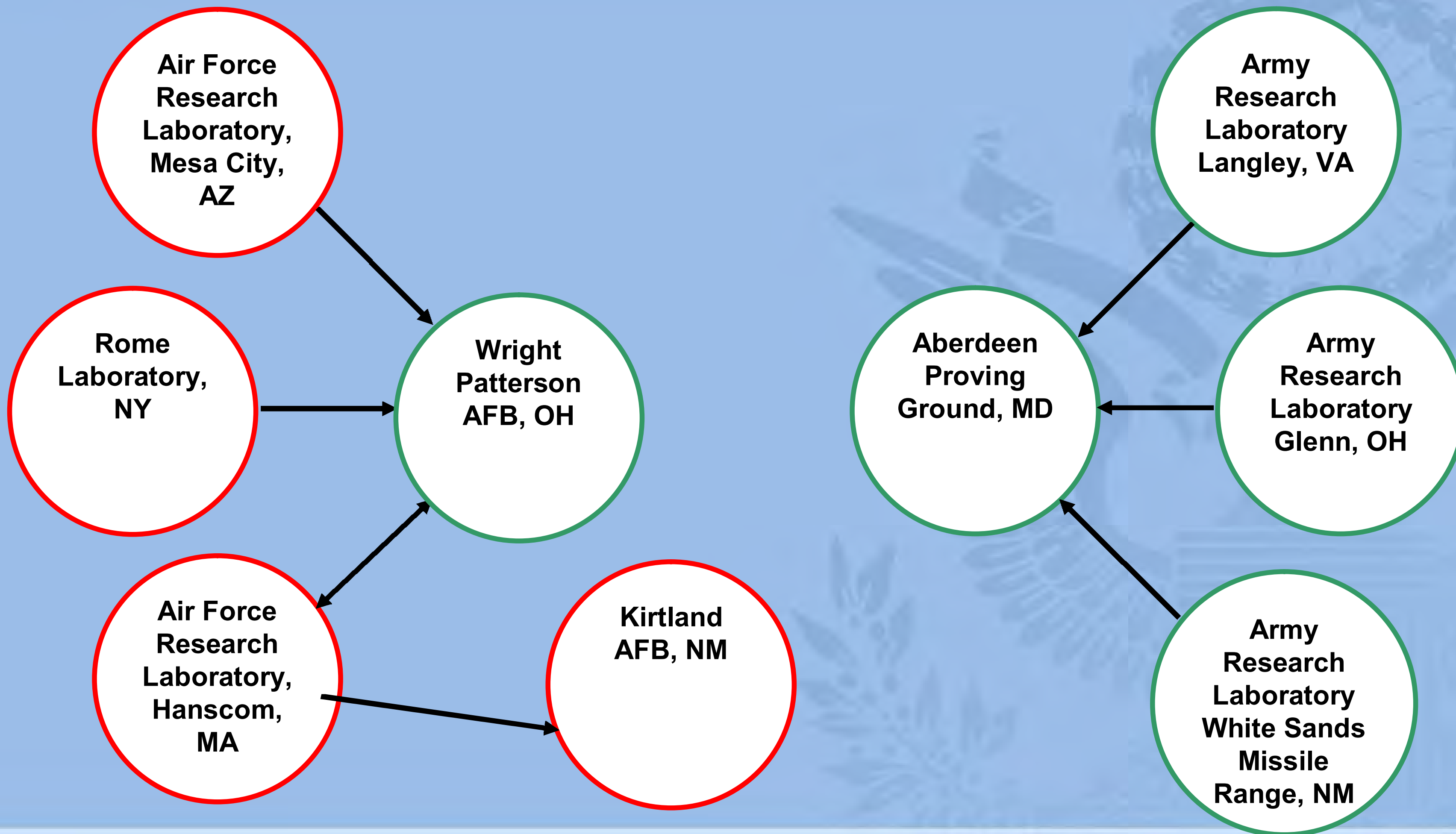
Rejected by the Commission

Sec. 184: Create a Naval Integrated Weapons & Armaments RD&A, T&E Center



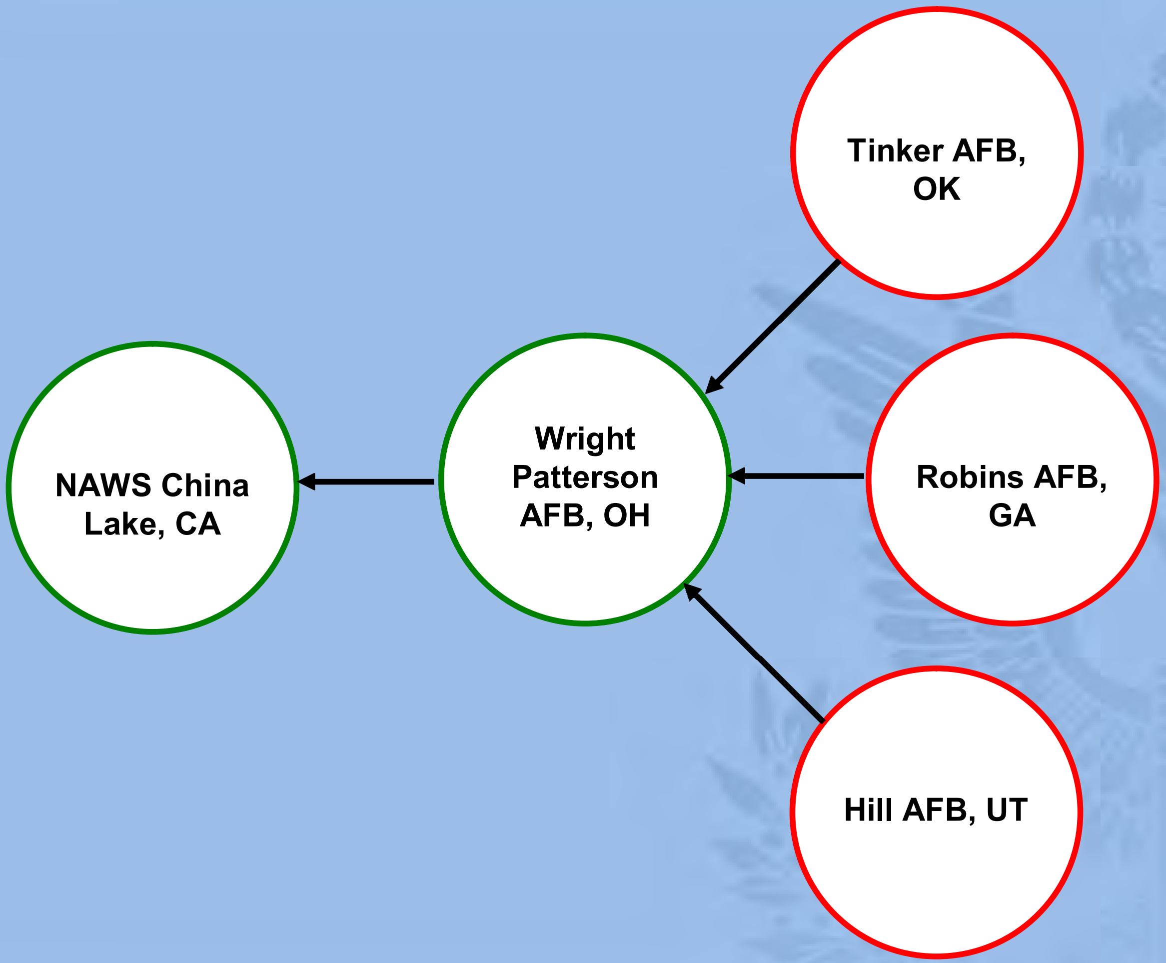
Approved with Concerns

Sec. 187: Defense Research Service Led Laboratories



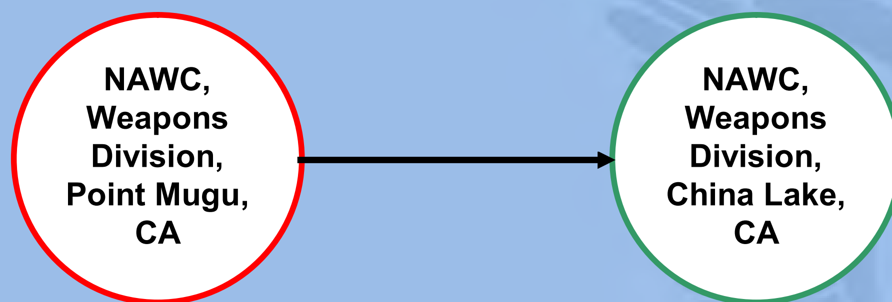
Modified by the Commission

Sec. 188: Establish Centers for Fixed Wing Air Platform Research, Development & Acquisition, Test & Evaluation



Approved by the Commission

Sec.190: Navy Sensors, Electronic Warfare, and Electronics Research, Development & Acquisition, Test & Evaluation



Rejected by the Commission

KEY ACTIONS

- Final Report delivered to the President on September 8th.
- The President had 15 days to review the final Report and decide to accept or reject in its entirety – Accepted September 15.
- If rejected the BRAC Commission would have had 45 days to amend and resubmit the report to the President – Not necessary.
- Congress now has 45 days to disapprove the final Report.
- The BRAC Commission final Report becomes federal law if not rejected by Congress.

Lessons Learned

- The next BRAC could be equally far-reaching and complex
- Excess capacity can be an advantage, e.g. Aberdeen.
- But "excess-excess" capacity is not.
- Military value, military value, military value.
- If the military value is sufficient, BRAC proposals can cost money, not save it.
- Success is determined years before BRAC starts, e.g. China Lake; Corona, L.A. AFB.

Lessons Learned
(continued)

- Commissioners may be chosen for political or military experience, but typically Commissioners do not have RDAT&E backgrounds, and are not particularly interested in RDAT&E per se.
- RDAT&E, and its components, are difficult for Commissioners to penetrate.
- Jointness may actually be key in the next BRAC. Even if not, Jointness is always an asset.
- BRAC proposals don't have to save the tax payers money to be viable.
- BRAC is a way to achieve change.

Getting Ready for a Future BRAC

- **Start now**
- **Develop your strengths**
- **Modern facilities sell; old run-down facilities don't sell.**
- **Face up to your weaknesses**
- **Face up to your weaknesses and correct them. This takes years.**

Conclusions

- There will be future BRACs
- The Commission recommends every 8 to 12 years.
- Congress probably would not support a BRAC in 2009.
- The next BRAC is recommended to begin in 2013 immediately following the 2013 QDR
- Sooner than 2013 is unlikely because of the QDR schedule and the presidential election cycle.
- 2013 may seem like a long way off, but it takes years to position a base for success, e.g. Los Angeles AFB, China Lake.

INTERNATIONAL ARMAMENTS COOPERATION

Precision Strike Technology Symposium

October 18, 2005

COL JAMES DENDIS, USAF

Office of the Under Secretary of Defense for Acquisition, Technology and Logistics

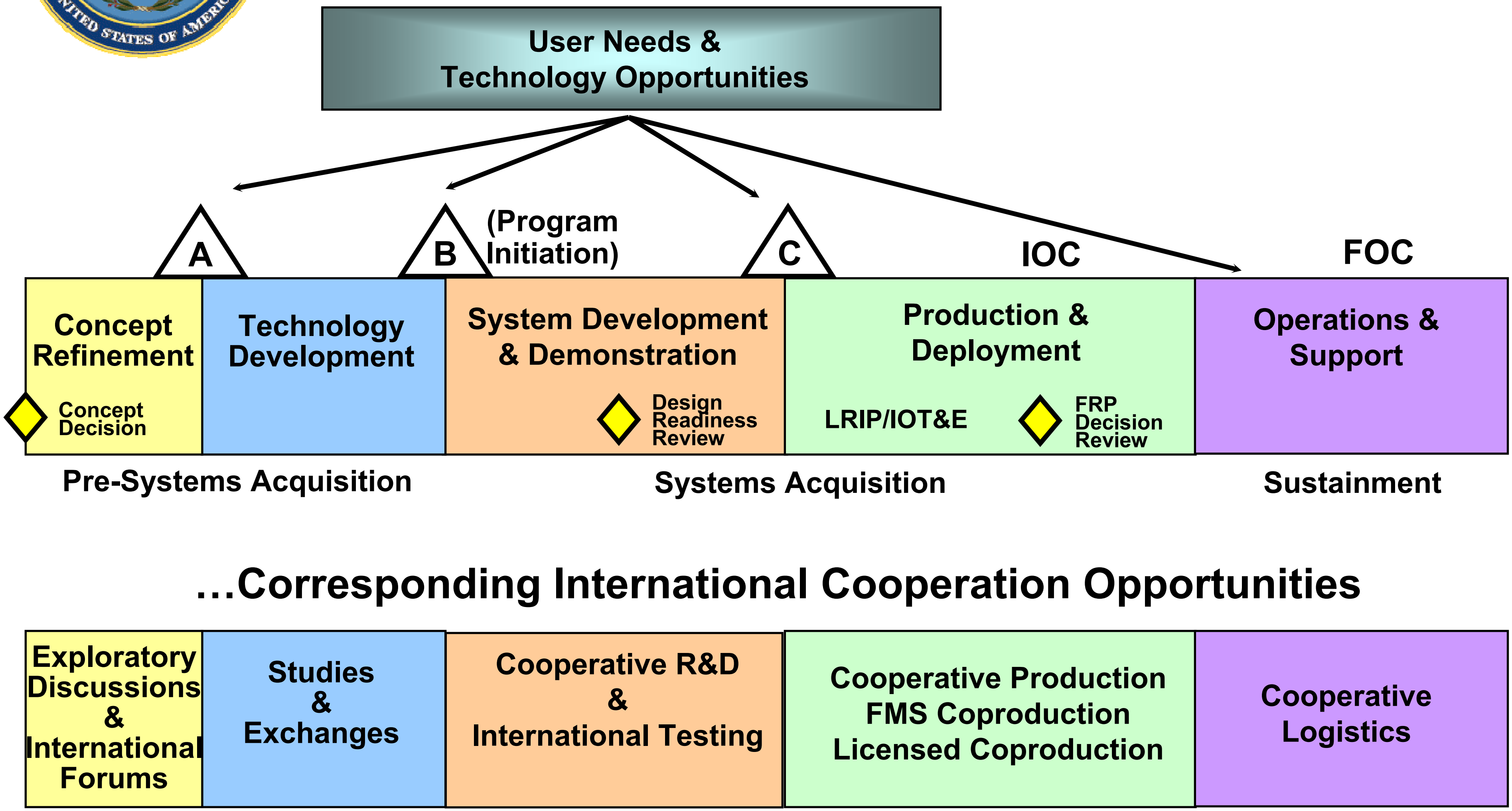
Directorate of International Cooperation

Definition: International Cooperative Program

An international cooperative program is any acquisition system, subsystem, component, or technology program with an acquisition strategy that includes participation by one or more foreign nations, through an international agreement, during any phase of a system's life cycle.

DoD Instruction 5000.2 May 12, 2003
Enclosure 9, para E9.4.1

Defense Acquisition Management Framework



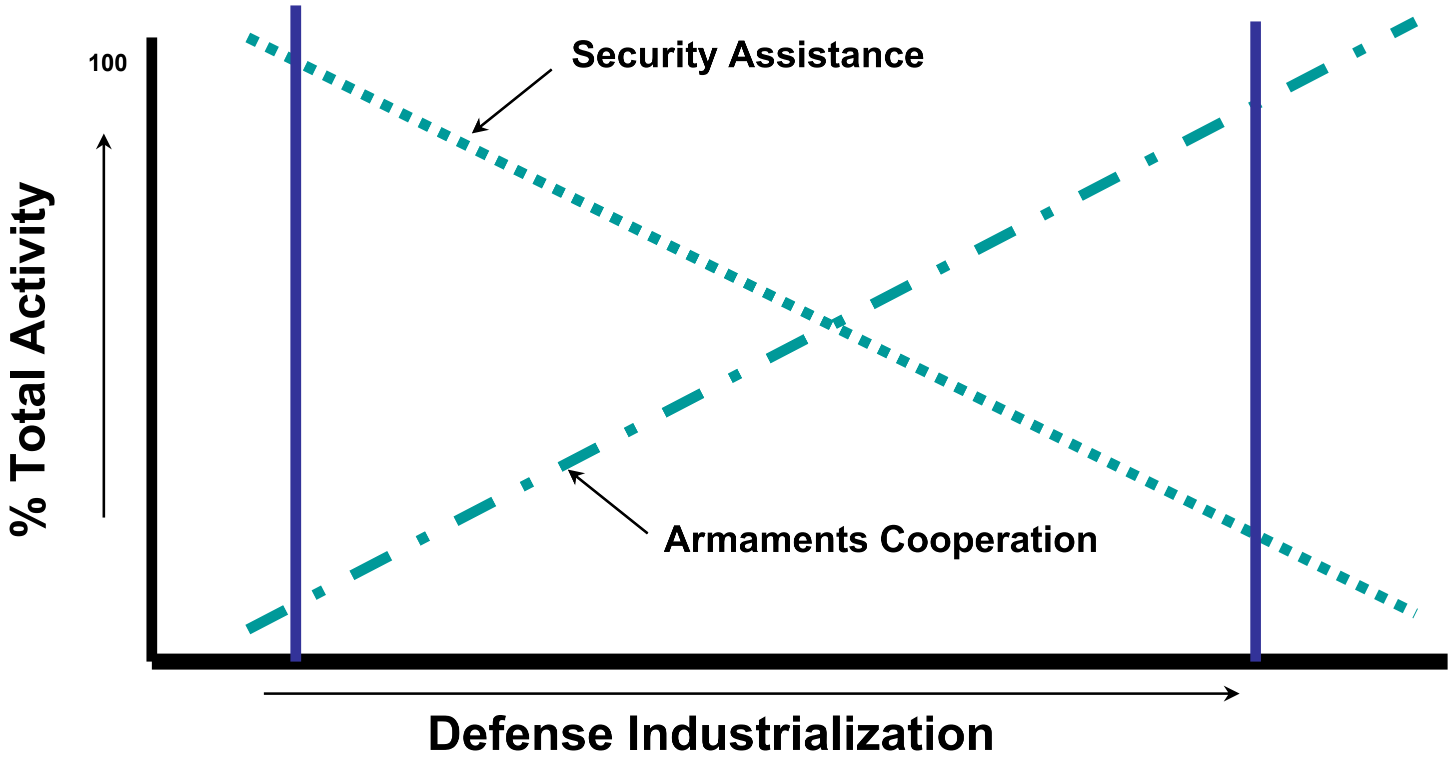
International Agreements

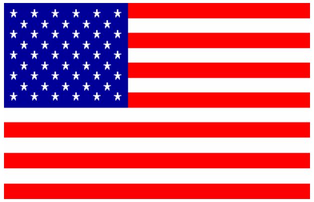
- Needed to:
  - satisfy laws
  - protect classified info and intellectual property
  - establish management structures
  - commit resources

- Are not treaties, but may be legally binding under international law

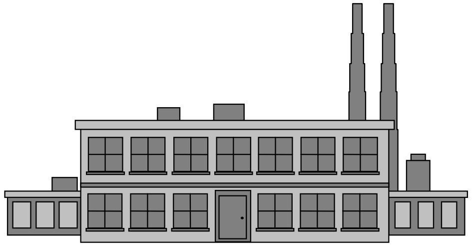
- A useful tool for structuring of international programs, and solidifying high-level commitment

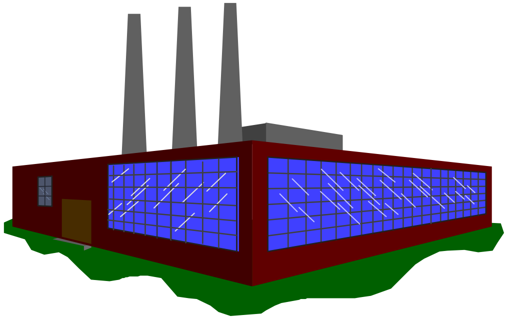
Cooperation vs. Assistance

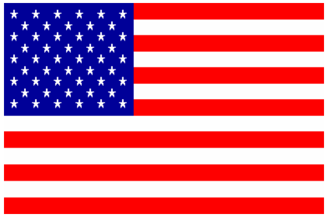




Why Cooperate?







Public Law

It is the policy of the United States to standardize equipment, including weapons systems, ammunition, and fuel, procured for the use of the armed forces of the United States stationed in Europe under the North Atlantic Treaty or at least to make that equipment interoperable with equipment of other members of the North Atlantic Treaty Organization.

10 U.S.C 2457

DoD Policy

"PMs shall pursue international armaments cooperation to the maximum extent feasible, consistent with sound business practice and with the overall political, economic, technological, and national security goals of the United States."

DoD Directive 5000.1, May 12, 2003
Enclosure 1, Para E1.1

DoD Policy: The DoD Acquisition Process

The DoD Components shall work with users to define capability needs that facilitate the following, listed in descending order of preference:

1) The procurement or modification of commercially available products, services, and technologies, from domestic or international sources, or the development of dual-use technologies;

2) The additional production or modification of previously-developed U.S. and/or Allied military systems or equipment;

3) A cooperative development program with one or more Allied nations;

4) A new, joint, DoD Component or Government Agency development program; or

5) A new DoD Component-unique development program.

DoD Directive 5000.1, May 12, 2003
Enclosure 1, Para E1.18

Policy: Competition

Competition shall provide major incentives to industry and Government organizations to innovate, reduce cost, and increase quality…Acquisition managers shall take all necessary actions to promote a competitive environment, including…ensuring that qualified international sources are permitted to compete.

DoD Directive 5000.1, May 12, 2003
Enclosure 1, Para E1.3

International Cooperation in Acquisition, Technology and Logistics

Department of Defense policy promotes international cooperative acquisition, technology and logistics activities, especially with allies and friends, that will enable the warfighter to be well prepared and supported for coalition operations…..Accordingly, I strongly encourage international cooperative activities that pursue standardization or interoperability of equipment and services to be used by the armed forces of the United States and coalition partners, provide access to technology from sources worldwide, and save money.

USD(AT&L) Memo

27 April 04

Contributors: Afghanistan & Iraq

AS OF 240500ZFEB05

AFGHANISTAN

Austria
Belgium
Canada
Croatia
Egypt
Finland
France
Germany
Greece
Hungary
Iceland
Ireland
Luxemburg
New Zealand
Slovenia
Spain
Sweden
Switzerland
Turkey

19

(#'s include ISAF Contributions)

AFGHANISTAN/IRAQ

Albania
Australia
Azerbaijan
Bulgaria
Czech Rep
Denmark
Estonia
Italy
Korea
Latvia
Lithuania
Macedonia
Mongolia
Netherlands
Norway
Poland
Portugal
Romania
Slovakia
UK
U.S.

21

IRAQ

Armenia
El Salvador
Japan
Kazakhstan
Moldova
Georgia
Ukraine

7

Contribution Totals (Approx.)			
	Afgh	Iraq	Total
U.S.	18,000	152,000	170,000
Coalition	9,800	24,700	34,500
Total	27,800	176,700	204,500

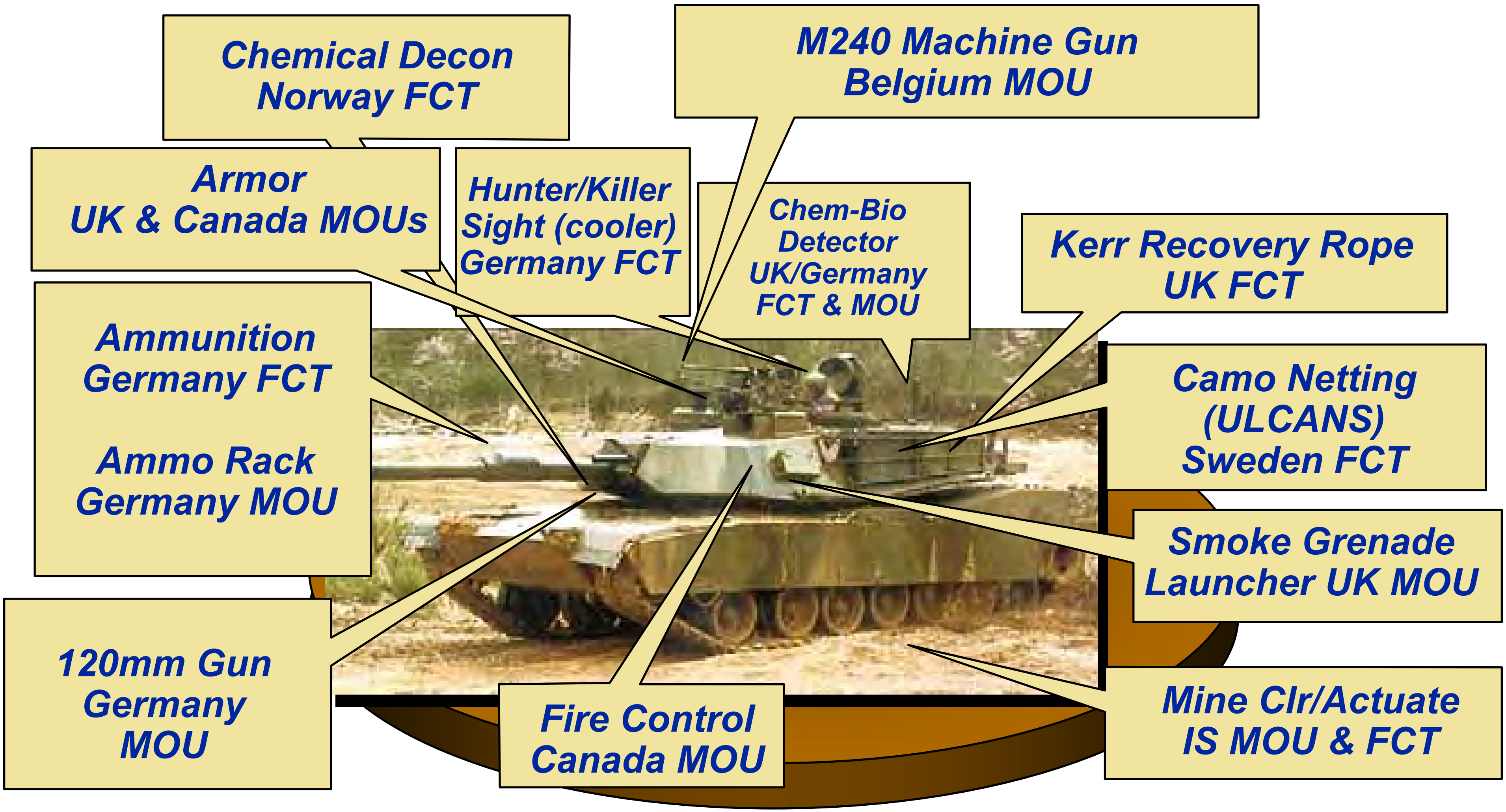
47 Countries
Supporting Afghanistan & Iraq

UNCLASSIFIED

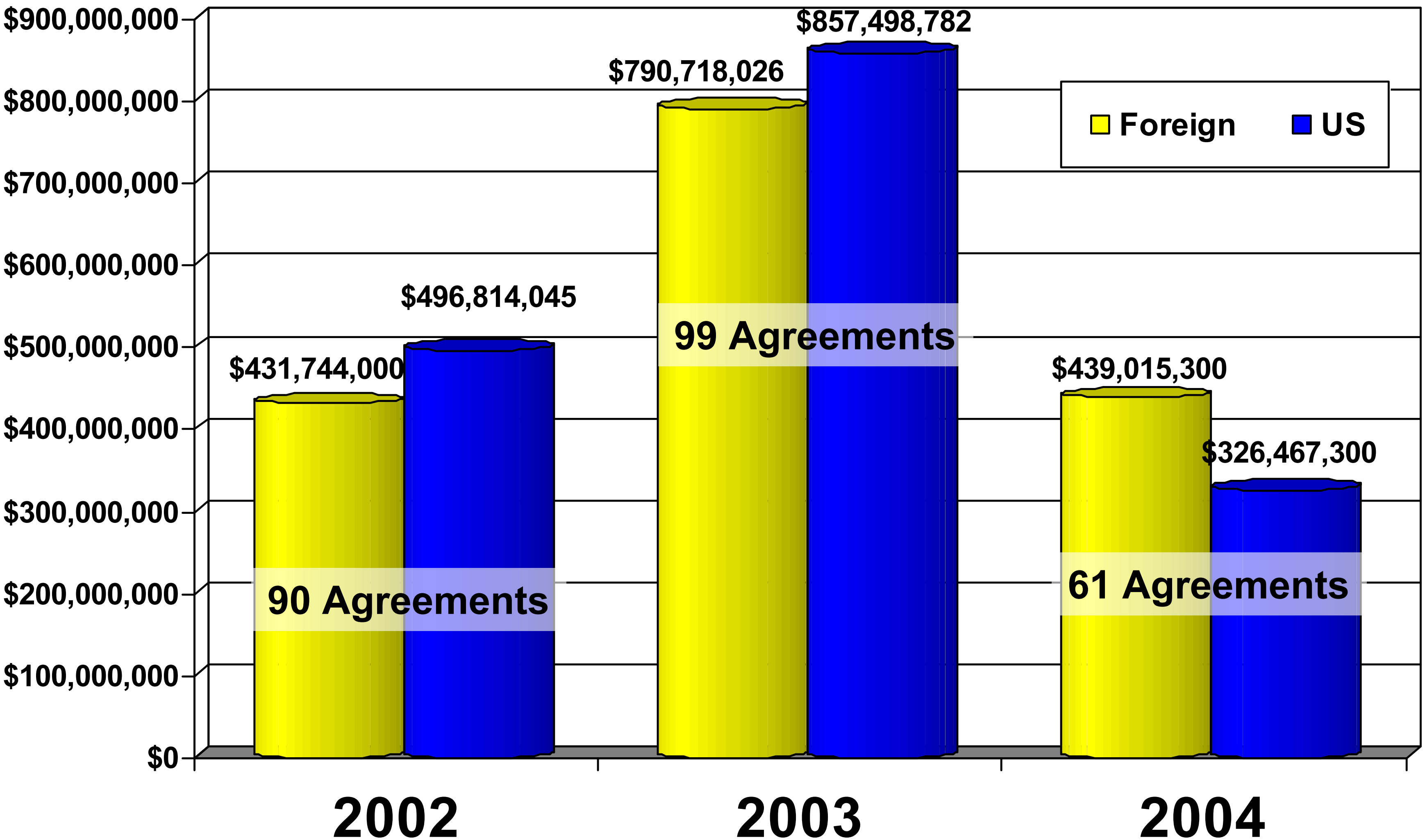
Interoperability

"…my concerns lie…with the future of all Alliance armaments cooperation endeavors. If we do not work together, I fear the growing technology gap between the United States and its NATO Allies will create an extremely divisive interoperability gap within the Alliance itself."

General Klaus Naumann (GEAR)
Chairman, NATO Military Committee
Address to US Congress and Senate, 23 June 97


Chemical Decon
Norway FCT
M240 Machine Gun
Belgium MOU
Armor
UK & Canada MOUs
Hunter/Killer
Sight (cooler)
Germany FCT
Chem-Bio
Detector
UK/Germany
FCT & MOU
Kerr Recovery Rope
UK FCT
Ammunition
Germany FCT
Ammo Rack
Germany MOU
Camo Netting
(ULCANS)
Sweden FCT
Smoke Grenade
Launcher UK MOU
120mm Gun
Germany
MOU
Fire Control
Canada MOU
Mine Clr/Actuate
IS MOU & FCT

R&D Contributions



Significant International Programs

- Joint Strike Fighter (JSF)

- Multifunctional Information Distribution System (MIDS)

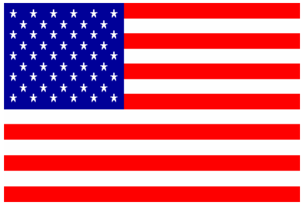
- Guided Multi-Launch Rocket System (GMLRS)

- Medium Extended Air Defense System (MEADS)

- NATO Alliance Ground Surveillance (AGS)

Impediments to Cooperation

- As They See Us
  - protectionist legislation
  - technology transfer (protection)
  - third country sales
  - competing programs
  - single year funding
- As We See Them
  - national champions
  - offsets
  - Fortress Europe



Offset Policy

No agency of the U.S. Government shall encourage, enter directly into, or commit U.S. firms to any offset arrangement in connection with the sale of defense goods or services to foreign governments.

Presidential Policy, April 16,1990

and Sec 123, PL 102-558, DefProdAct (amnd)

International Defense Cooperation Activities

- **Coop R&D Programs: > 500 with 24 countries**
- **Information Exchange Agreements: > 600 with 24 countries**
- **Engineer and Scientist Exchange: > 80 people w/10 countries**
- **Coproduction Programs: 50 with 19 countries**
- **Armaments Coop MOUs: 29 countries**
- **Reciprocal Procurement MOUs: 21 countries**
- **Acquisition and Cross-Servicing Agreements: 80 agreements**
- **Logistics Support MOUs: 11 countries**
- **Biannual multilateral NATO, PASOLS, and other meetings**

Useful Websites

International Armaments Cooperation Handbook
http://www.acq.osd.mil/ic/handbook.pdf

DAU Continuous Learning Courses
www.dau.mil
(Click on Continuous Learning)

AT&L Knowledge Sharing System (AKSS)
http://deskbook.dau.mil/jsp/default.jsp
(Supersedes the Acquisition Deskbook)

Defense Acquisition Resource Center
http://akss.dau.mil/darc/darc.html
Includes the DoD 5000 documents and the Defense Acquisition Guidebook

Overview of 3rd Party Targeting Demonstration Using the APL Precision Target Locator Demonstrator

Distribution Statement A
Approved for public release: distribution is unlimited

Ben Huguenin *Joe Schissler*

October 18, 2005

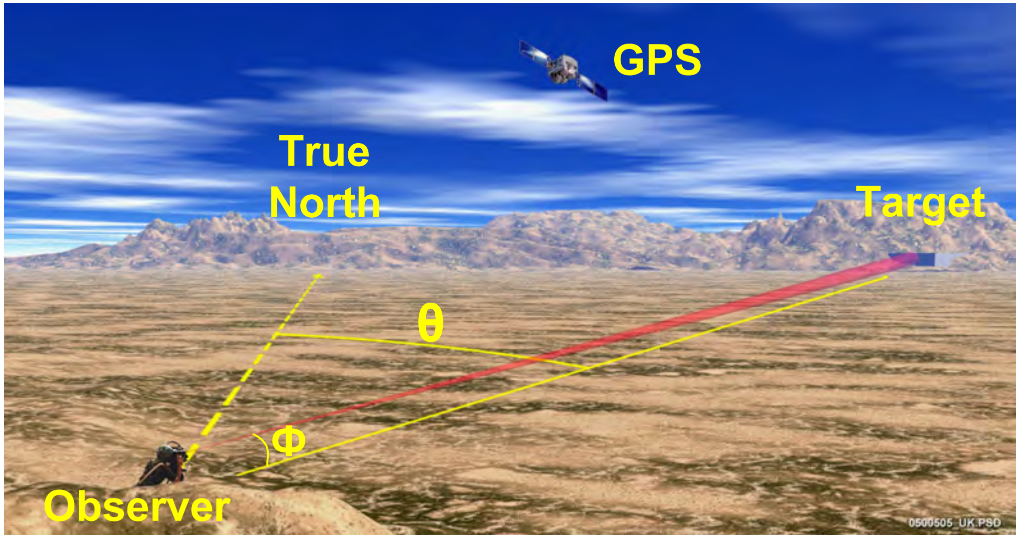
The Johns Hopkins University
APPLIED PHYSICS LABORATORY

Agenda

- Introduction
- Precision Target Locator (PTL) Demonstrator
- Tomahawk Weapon System (TWS)
- Demonstration details and results
- Summary

Introduction

- The PTL Demonstrator is a self-contained, man-portable, tripod-mounted, target location device with accuracies an order of magnitude better than current systems



- Question: Can we demonstrate the full utility of this device by quickly and accurately getting the target location to a precision weapon?

PTL Demonstrator

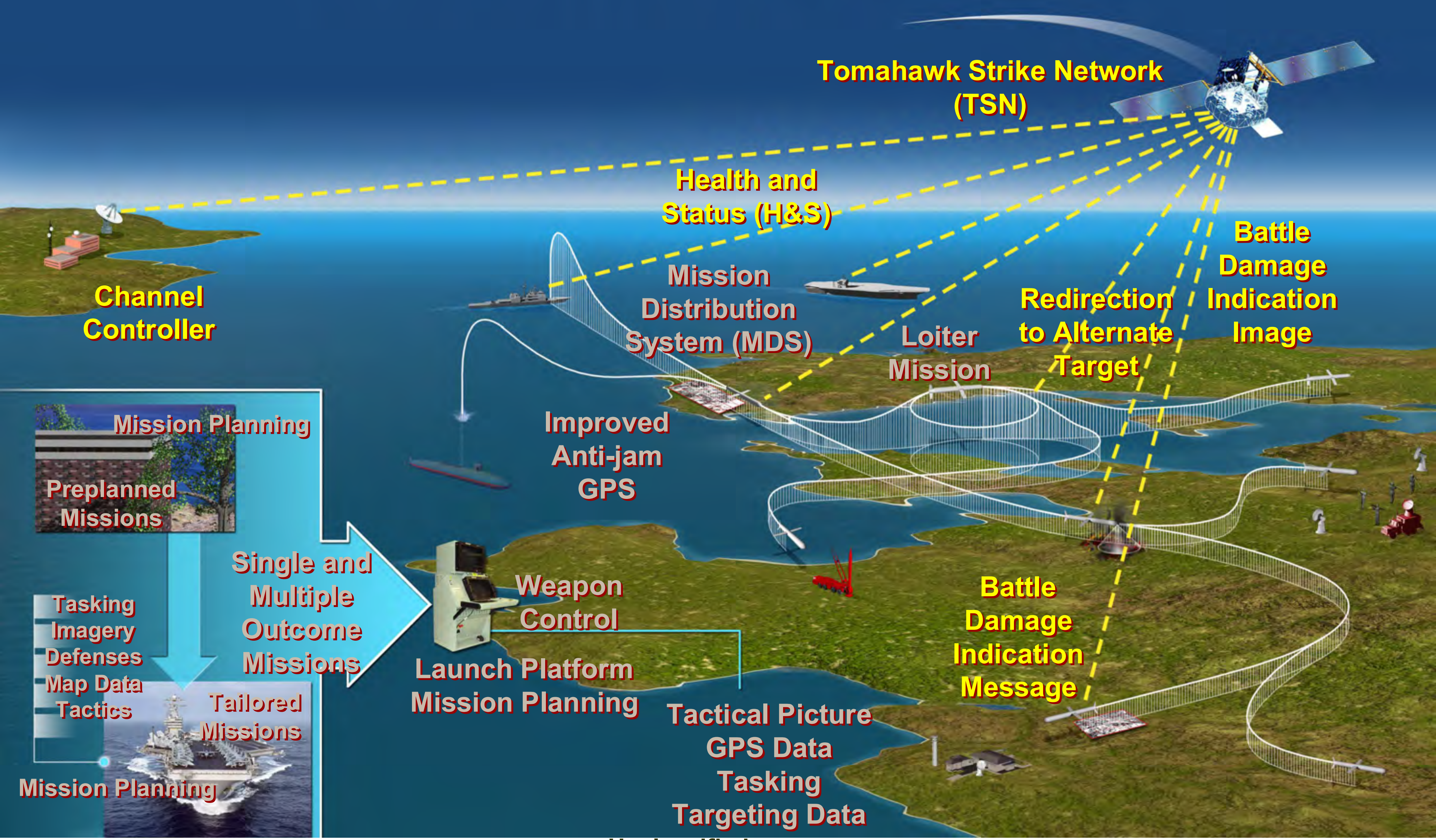
- GPS determines own location
- Laser range finder determines distance to target
- Inertial Navigation System (INS) determines angles to target
- Windows CE-based system computes target location very accurately; APL's goal was < 7m error at 7 km
- Integrated off-the-shelf components weigh 19.7 lbs, including battery

Accuracy Testing Results

Root-Mean-Square (RMS) Errors (m)				
Target Range	**Target Distance**	**Cross Range**	**Vertical**	**Downrange**
Aberdeen	5 km	3.2	3.1	2.6
Aberdeen	7 km	4.3	2.7	3.6
Fallon*	5 km	4.7	1.4	3.4
Fallon	7 km	6	1.8	3

* Three ranges between 4.5 and 4.8 km

Tomahawk Weapon System Baseline IV Capability

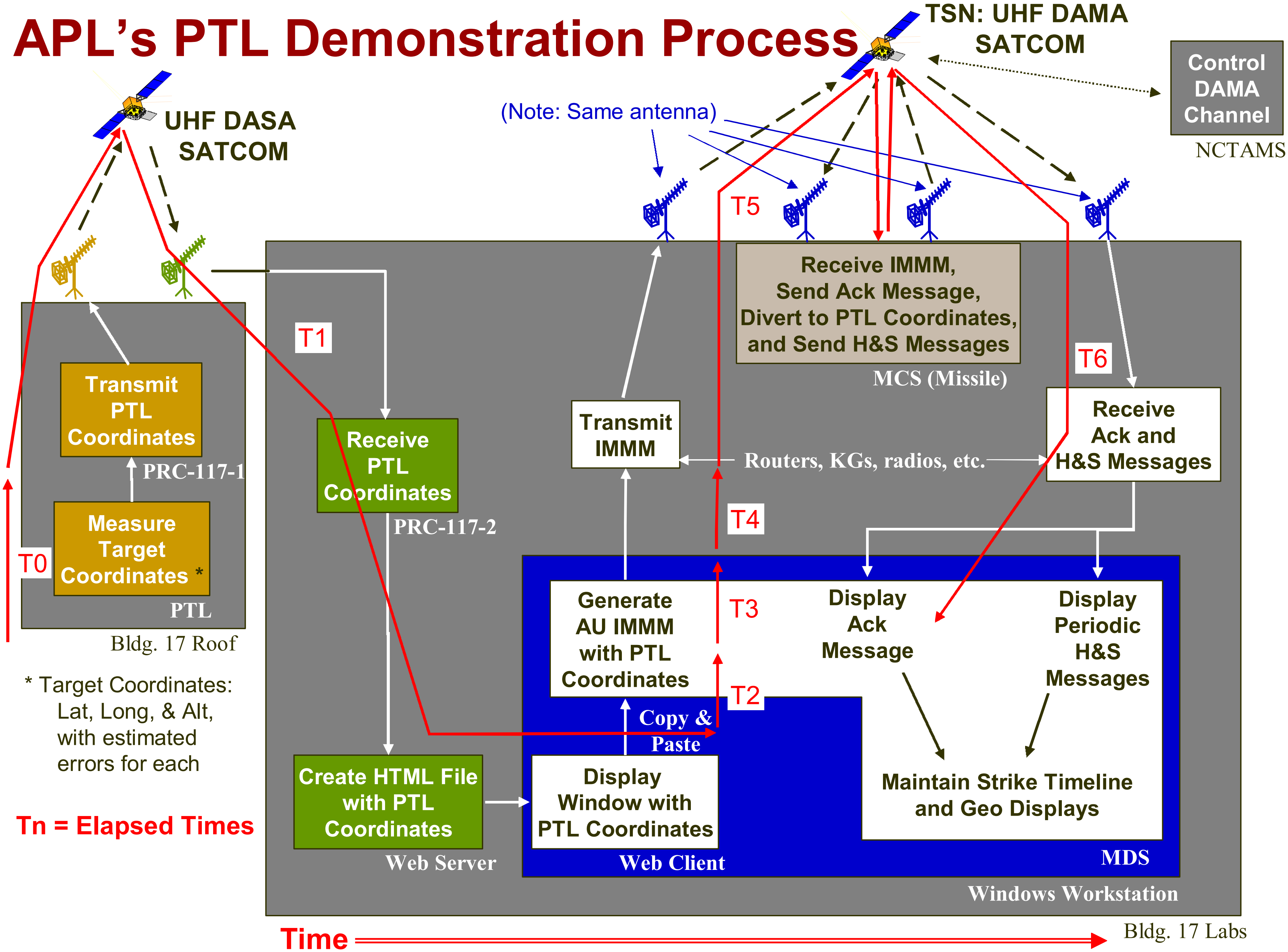


Unclassified

Demonstration Scenario

- SOF observes target and submits CAS request
- On-going Tomahawk strike with a missile that can be redirected
- TACAIR unavailable; CAS request paired to Tomahawk
- SOF measures target location with PTL and electronically sends to TWS
- TWS sends In-flight Mission Modification Message (IMMM) to redirect missile
- Missile diverts to PTL-measured target coordinates
- Scenario consistent with 2nd Fleet's draft Tactical Bulletin on Third Party Targeting

APL's PTL Demonstration Process



* Target Coordinates: Lat, Long, & Alt, with estimated errors for each

Tn = Elapsed Times

Unclassified

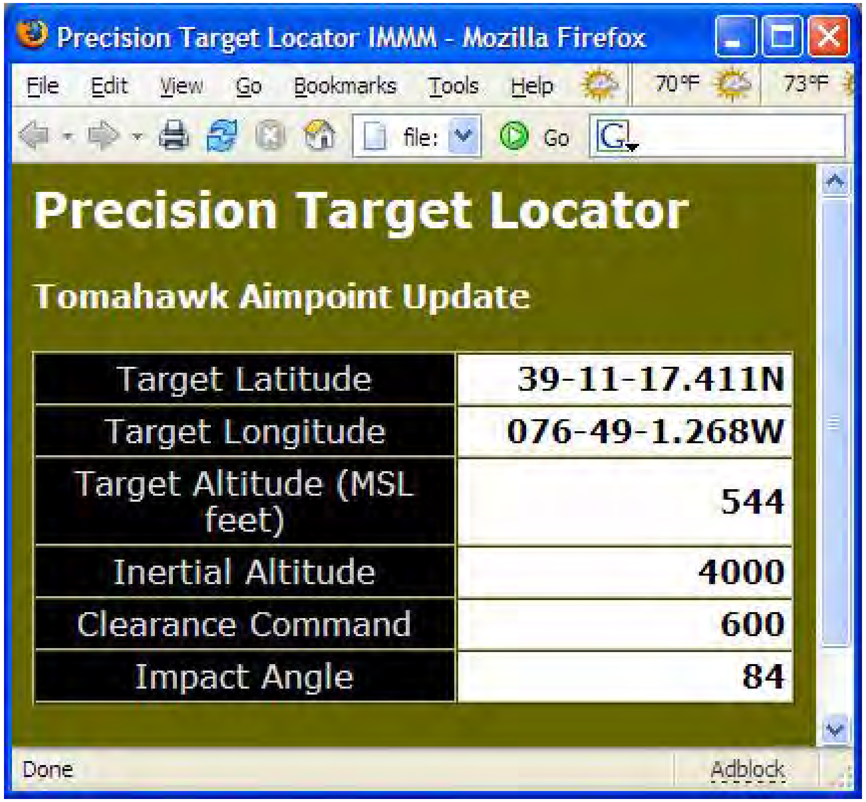
Target Identification

Measuring, Transmitting, and Receiving Target Coordinates

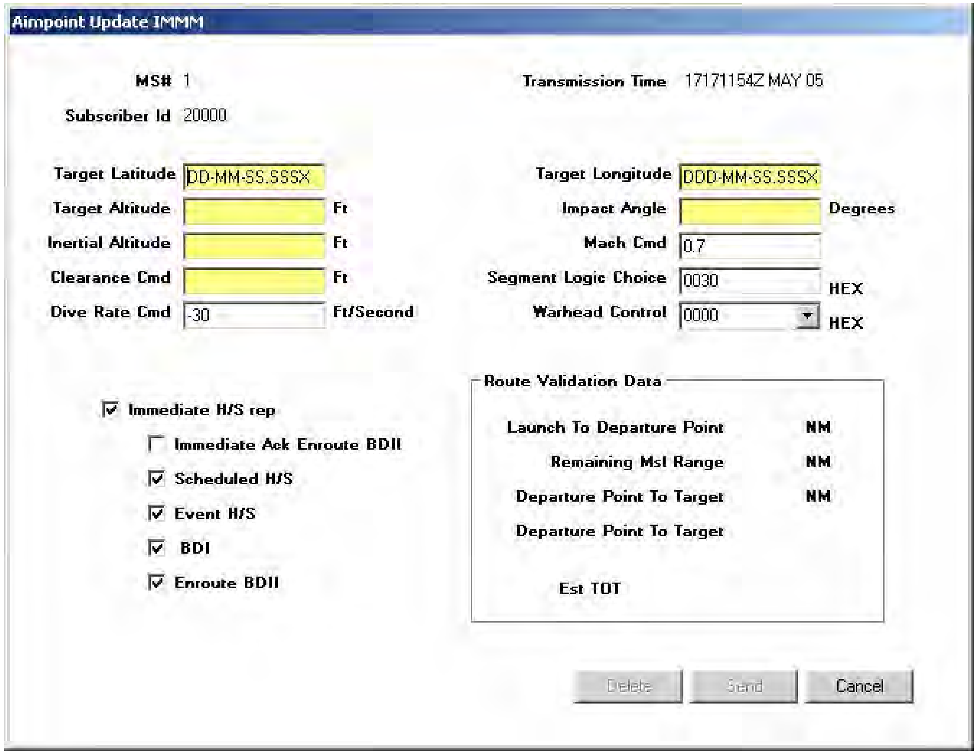



PTL Web Client and Tomahawk MDS

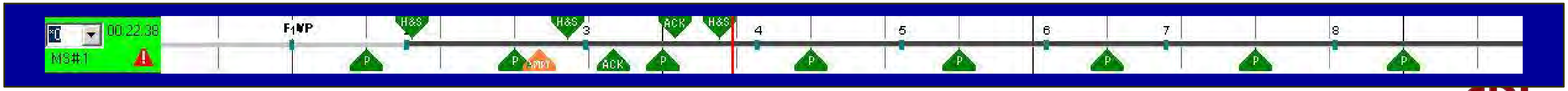
Web Client



MDS

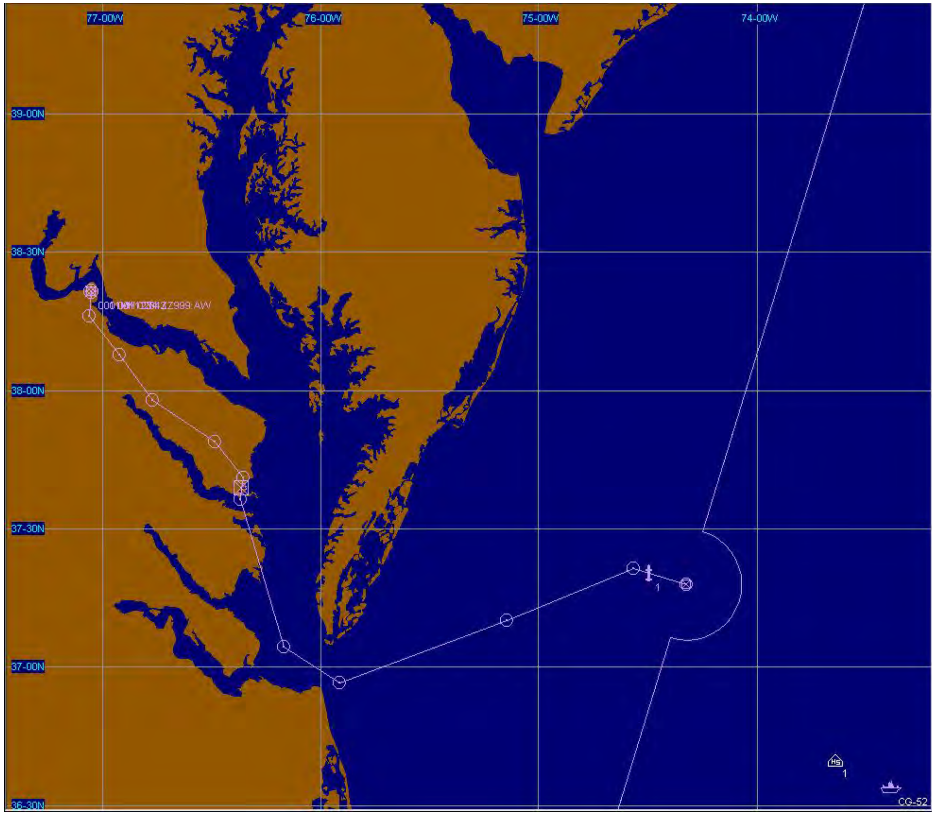


MDS Timeline

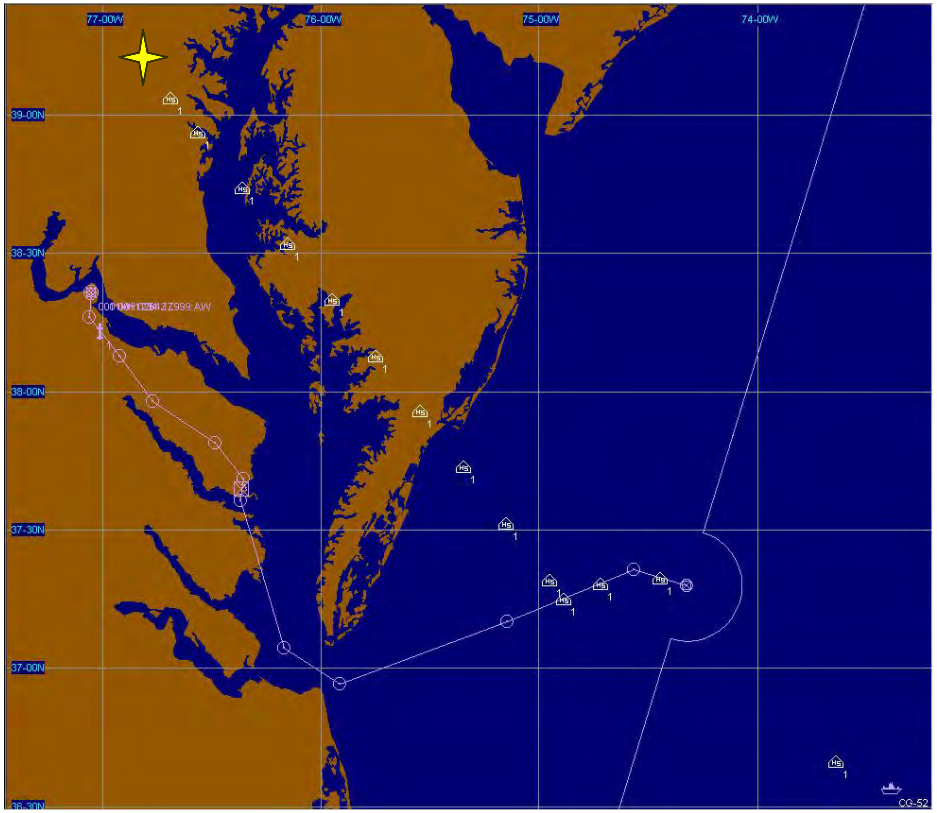


Pre-planned Tomahawk Mission and Result after Redirection

As Planned

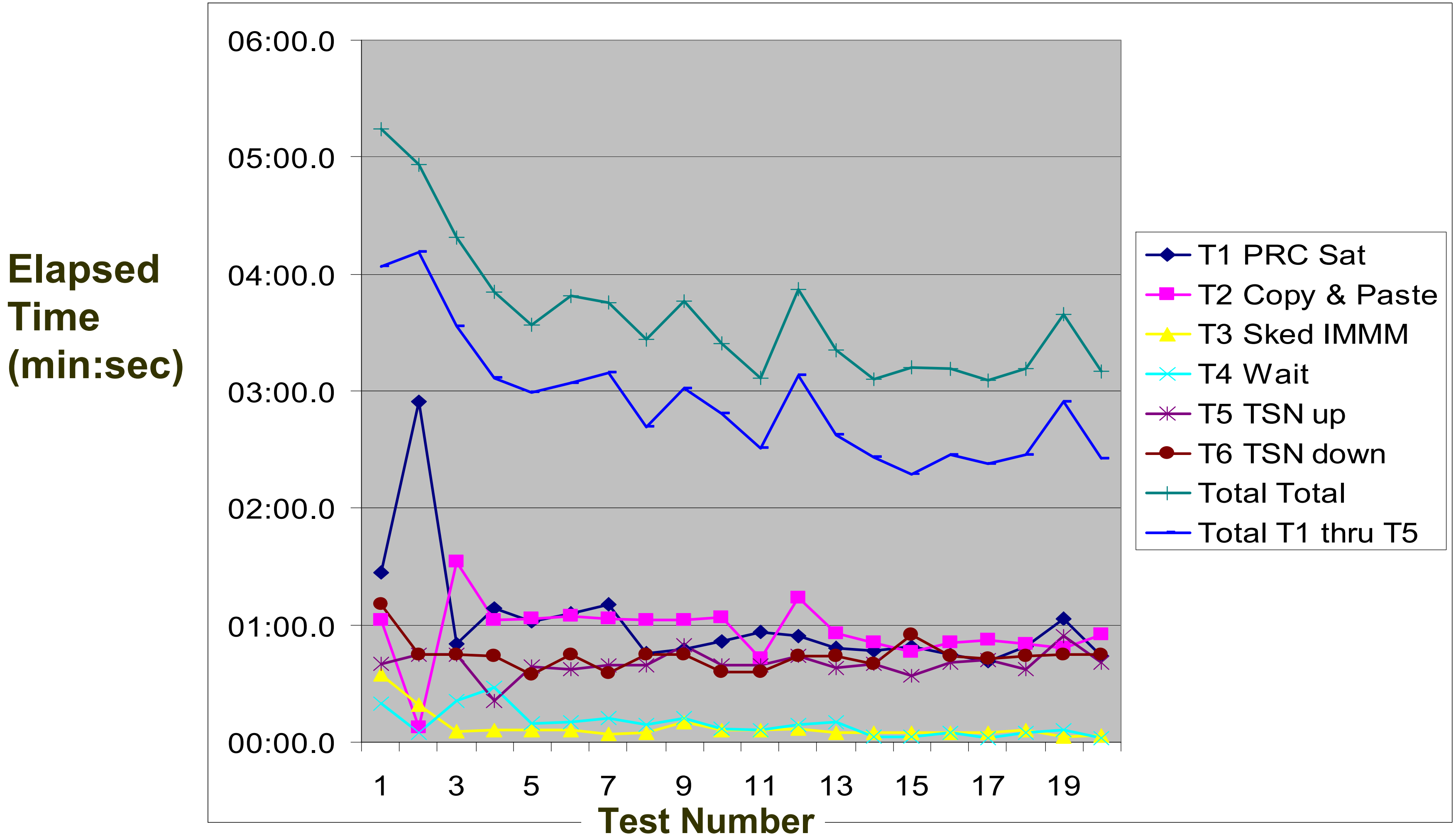


After Redirection



MDS Geo Displays

Demonstration Timing Results



Summary

- Off-the-shelf, operational, and simulated systems were integrated into an end-to-end targeting demonstration
- Expected time from good target location to missile redirection is about 1.5 minutes
- Total reaction time needs to include other times
  - PTL Demonstrator set-up and alignment
  - Command decisions
  - Missile flight
- PTL Demonstrator technology is transitioning to industry

Demonstrated accurate and timely 3rd Party Targeting using APL's PTL Demonstrator and Tomahawk Redirection

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Acronyms and Abbreviations

Ack	–	Acknowledgement
Alt	–	Altitude
AU	–	Aimpoint Update
CAS	–	Close Air Support
DAMA	–	Demand Assigned Multiple Access
DASA	–	Demand Assigned Single Access
GPS	–	Global Positioning System
H&S	–	Health & Status
HTML	–	Hyper-Text Markup Language
IMMM	–	In-flight Mission Modification Message
INS	–	Inertial Navigation System
Lat	–	Latitude
Long	–	Longitude
MCS	–	Missile Communications Simulation
MDS	–	Mission Distribution System
NCTAMS	–	Naval Computer & Telecommunications Area Master Station
PTL	–	Precision Target Locator
SATCOM	–	Satellite Communications
SOF	–	Special Operations Forces
TACAIR	–	Tactical Aircraft
TSN	–	Tomahawk Strike Network
TWS	–	Tomahawk Weapon System
UHF	–	Ultra High Frequency

Precision Strike Technology Symposium – 05, C4ISR

Just-in-time Strike Augmentation (JITSA)

Major Conflict through Stability and Protection Operations

Mr. Gregory K. Jenkins
AAC/XR
19 October 2005

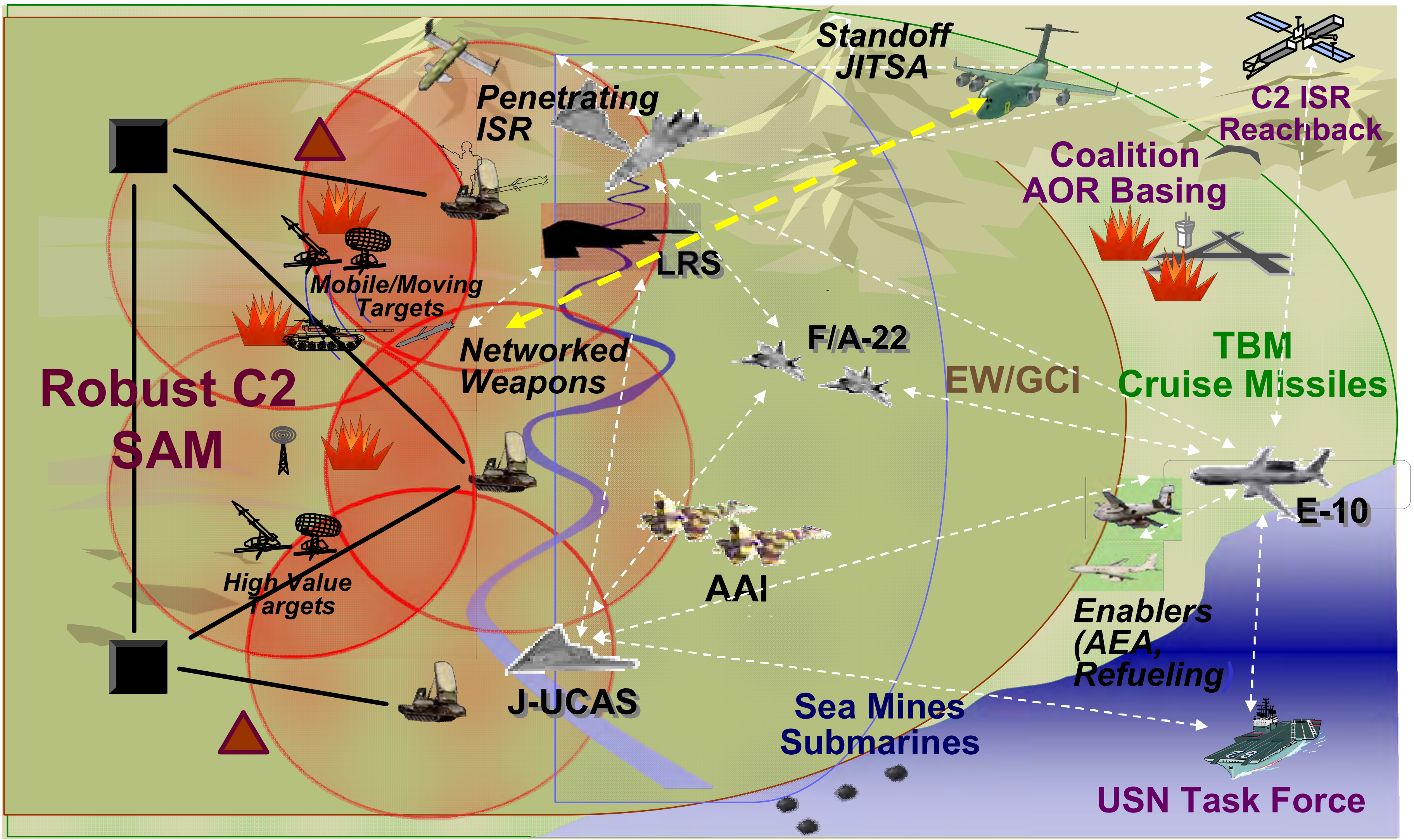
Overview

- JITSA can be a back breaker to large scale enemy operations
- Efficient use of force structure in large scale, stability and protection operations
- Not platform dependent
  - No Integration Costs
  - Shorter Time to Warfighter
- Potential near term DOTMLPF solution to current TCT and PISR needs

The Golden Rule: " This briefing is intended to stimulate discussions regarding creative ways of employing existing assets but is _not_ a USAF-endorsed concept at this time"

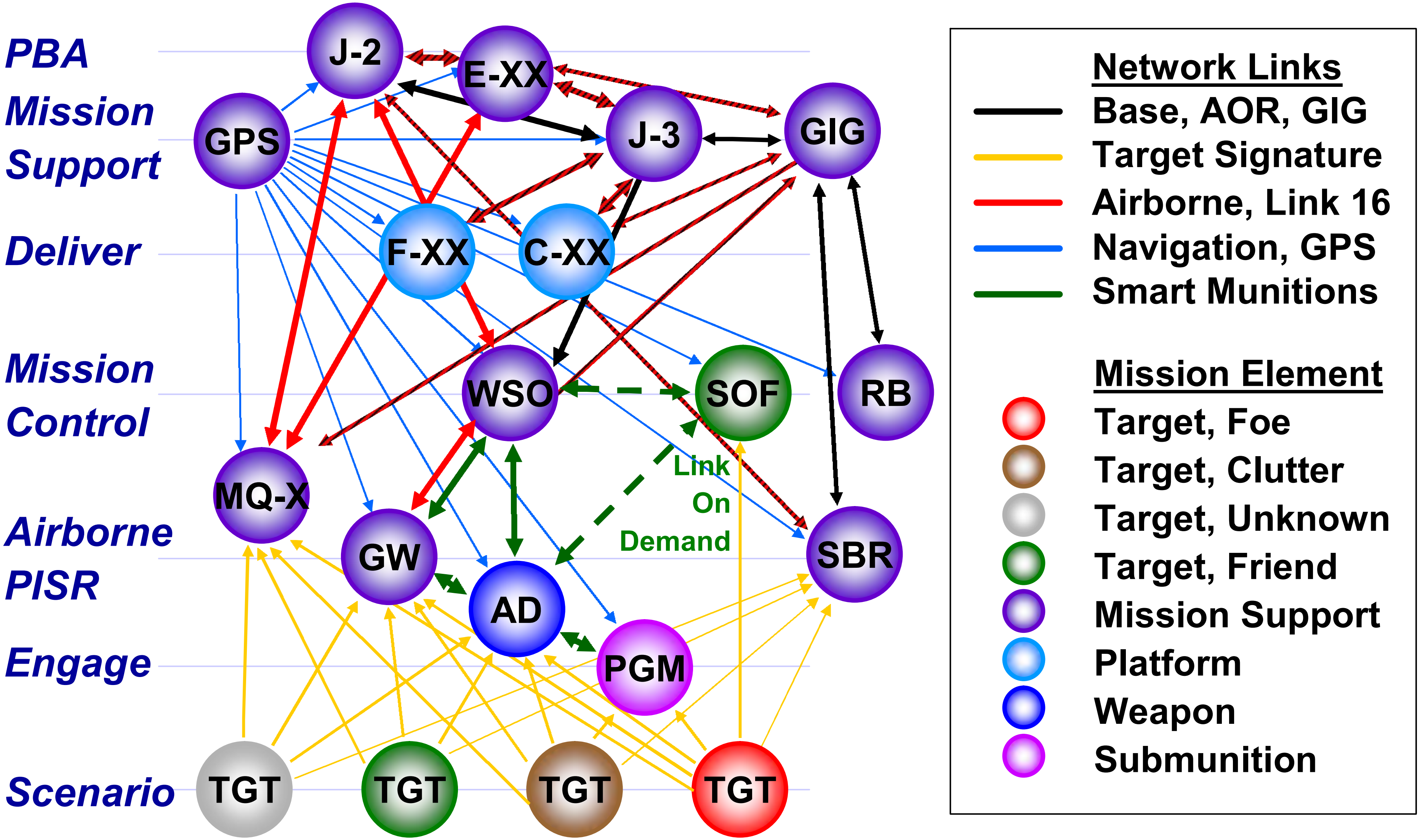
Strike OV 1

Strike Threat Environment, Modified for JITSA Delivery of LE-NCW



SV-1, Network Centric Weapons

PISR & F2T2EA Moving & Mobile Time Sensitive - Pre-emptive Model



Kill Chain Models: a Tale of 2 Dogs

Responsive Model

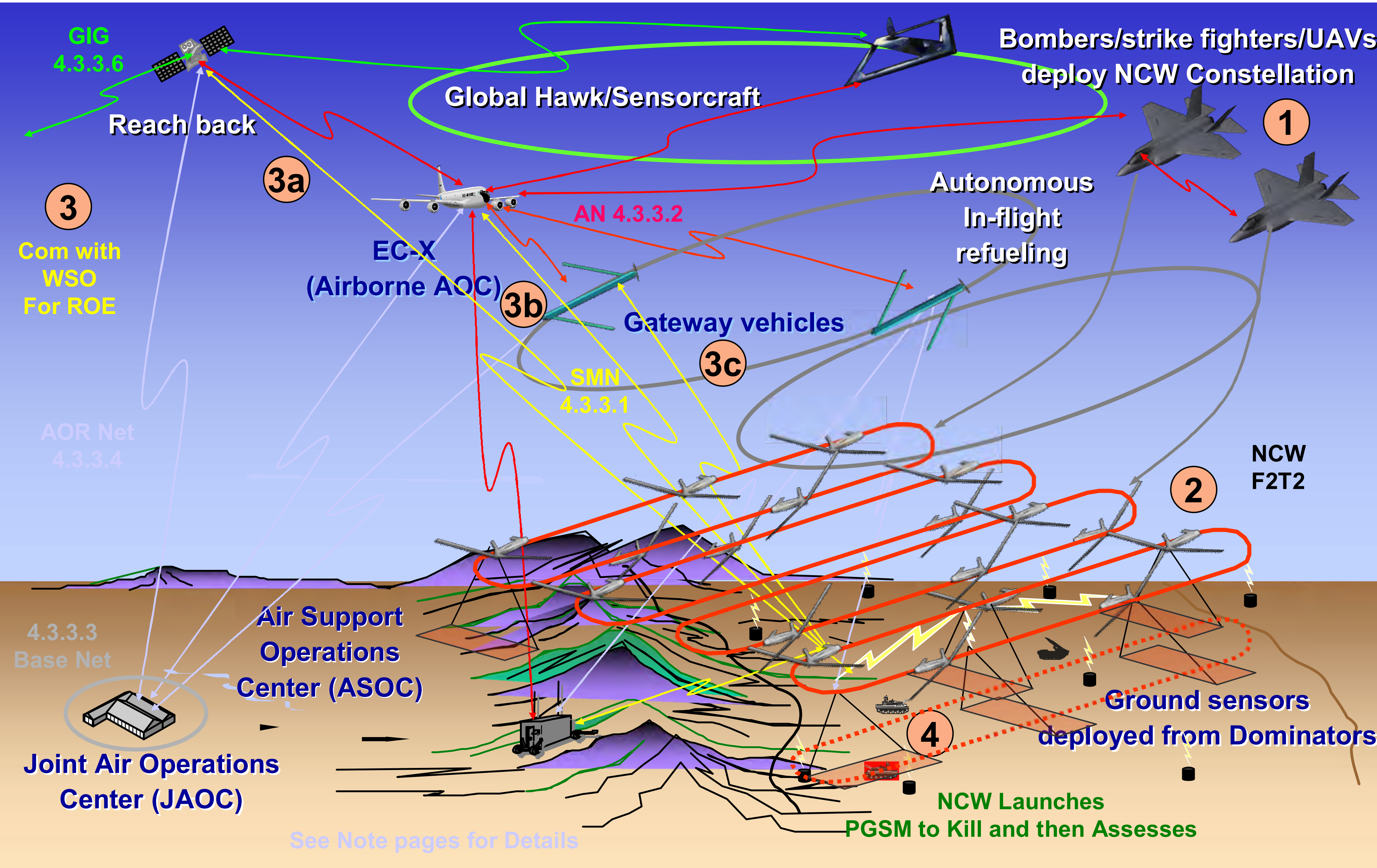
- Platform Centric
- Reliable – Reactive - Static
- Effective <u>when called upon</u>

Pre-emptive Model

- Network Centric
- Agile – Quick - Persistent
- Already <u>in Play</u>

Long Endurance Network Centric Weapon (LE-NCW)

Pre-emptive Kill Chain Model, Showing COM interactions for Single or Multi-Tier Weapons Operations



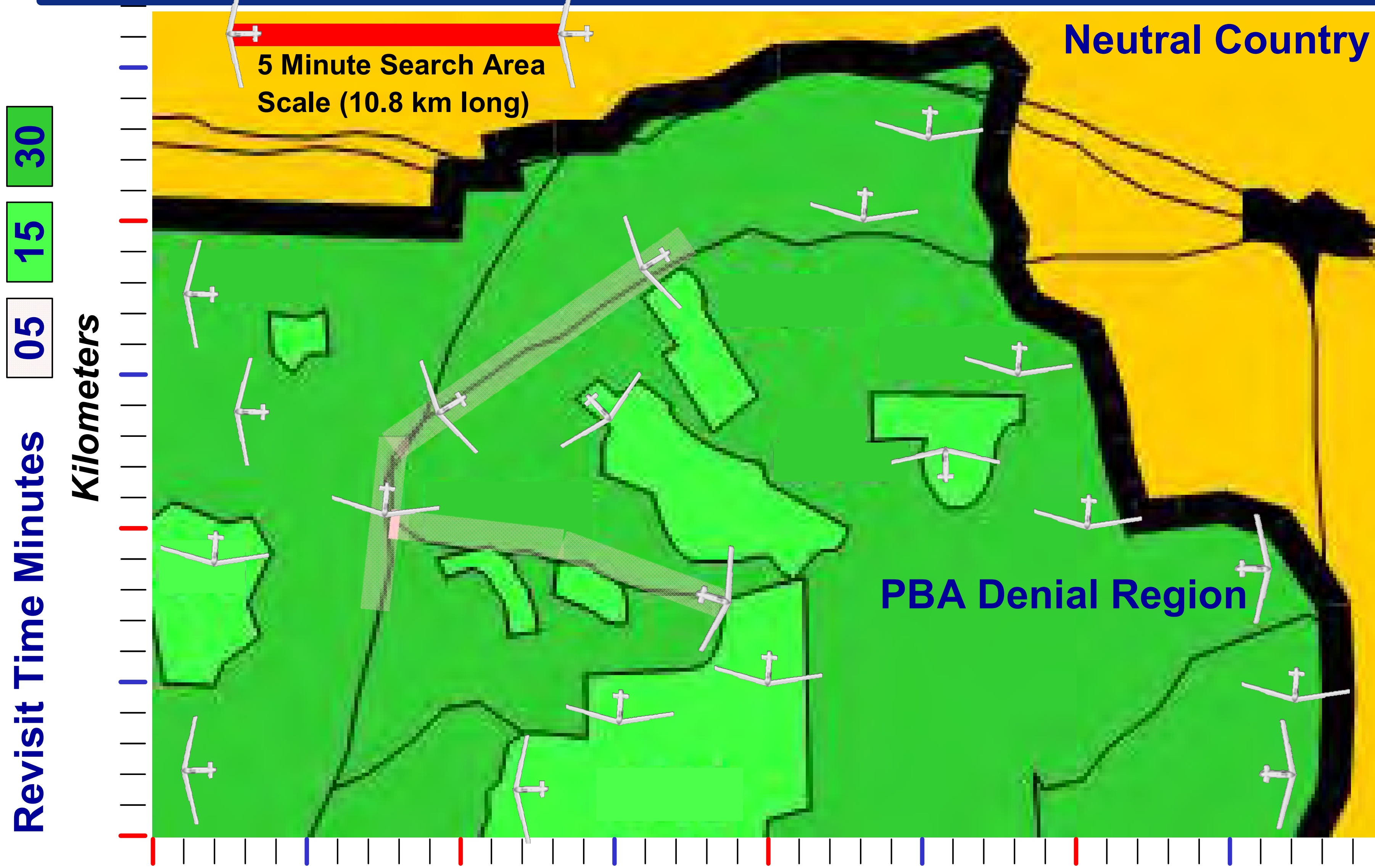
Sensor Fusion

Collection and some ATR Functions onboard NCW, WSO Workstation Fusion

- Acoustical: Primary situation awareness aid
  - Ballistic shock and SIGINT detection events reported to WSO
  - Defensive action either pre-planned or command directed
- Secondary target cuing and identification sensor
  - ELINT Detection event with spectral analysis reported to WSO
  - Targeting action dependent on mission profile
    - Cue for engage, according to prescribed tactics
    - Defensive action my be required until command direction decision
- LADAR: Primary target identification and cuing using range, spatial and thermal contrast data (Tri-Mode Near term)
  - Detection reported with IMINT and ATR resolution etc.
  - Engages high priority targets, WSO has ROE over ride
- SAR: Secondary target cuing and GMTI from Gateway
  - Machine to Machine cuing and tasking with WSO over ride
  - SIGINT also processed and reported
- Navigation: INS/GPS with DTED aided terrain roughness and avoidance

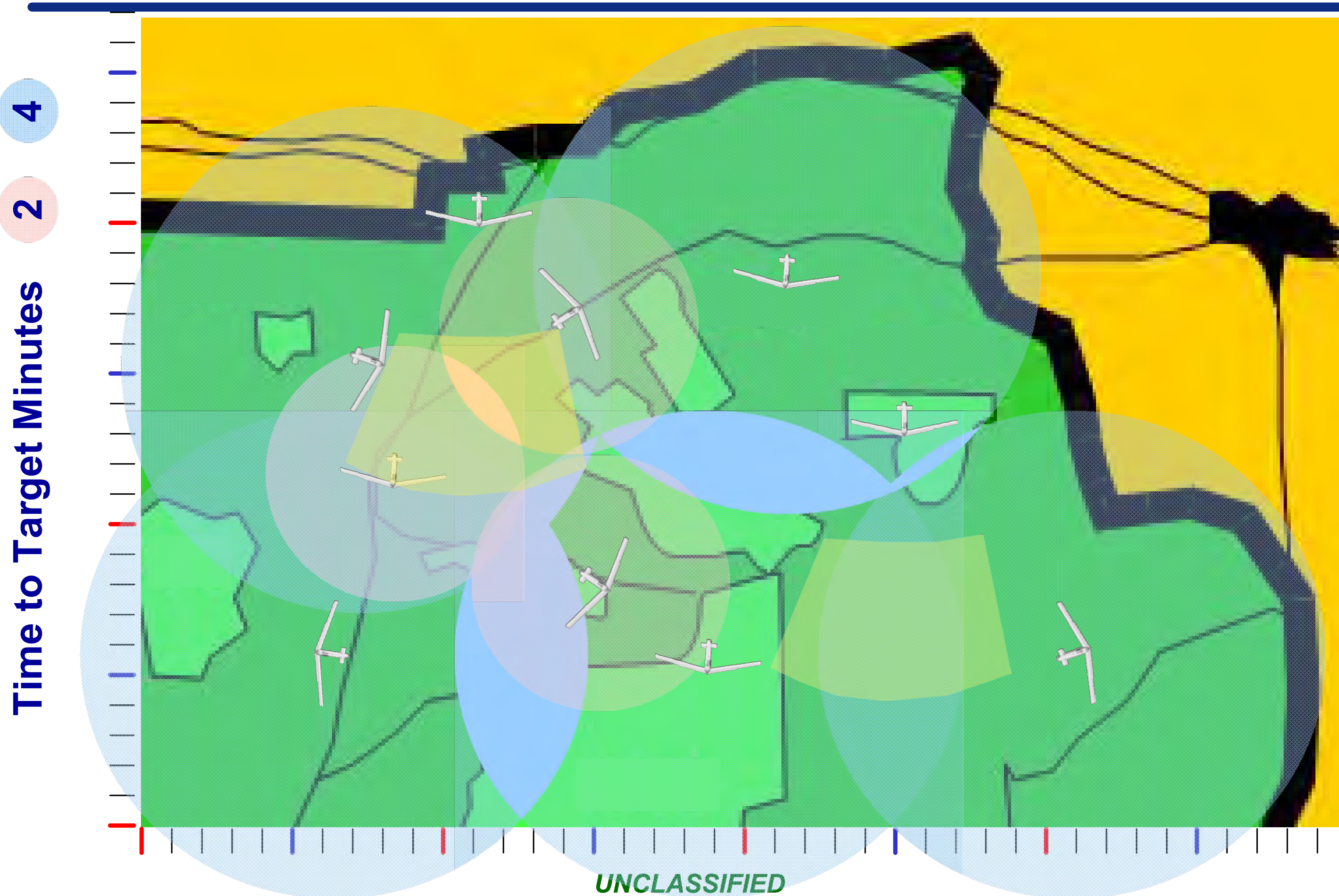
Single Tier CONEMP Mission Management

Objective: Manage Revisit Time, Ensuring Enemy OODA Loop Denied



Two Tier CONEMP Mission Management

Objective: Manage Time to Target, Architecture Includes Cuing System



Potential JITSA Near Term Airlifter Platforms

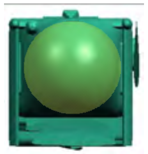
Just-in-Time Strike Augmentation (JITSA)

- Requires no new OFP software
- No New Aircraft modifications
- Limited to No crew special training
- No impacts on Airlifter program
- Does Require WSO & Roll-on/off support equipment
- Additional Airlifter Force Structure eliminates potential burden on Airlift
- NO Transshipment – Direct delivery
- Doesn't Need Air Bridge End Node

LE-NCW Storage / Shipping Container Configuration

Standard Air Drop Palette, BIT etc., Incorporated to Facilitate JITSA Operations

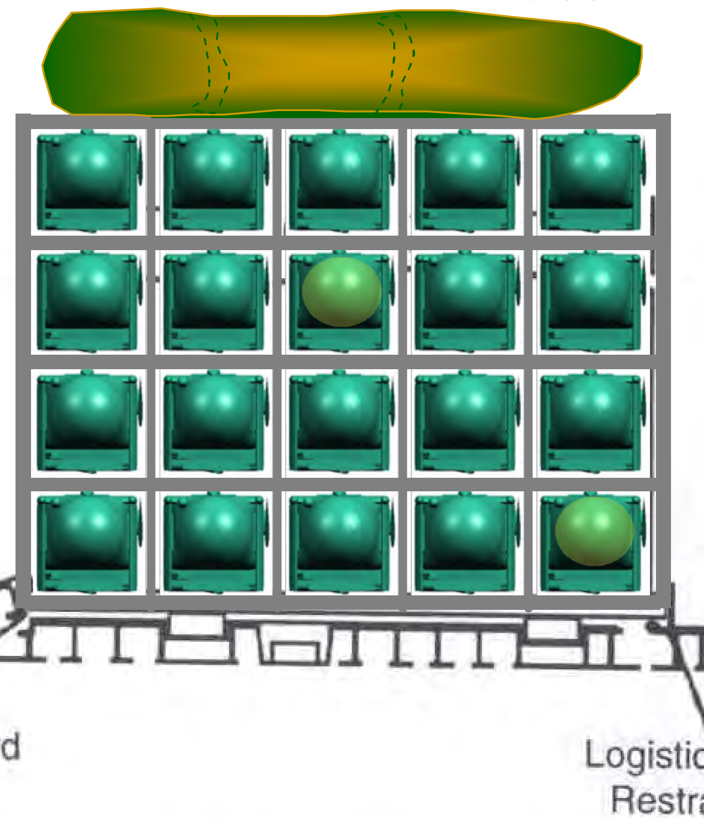
Area Dominator (18)

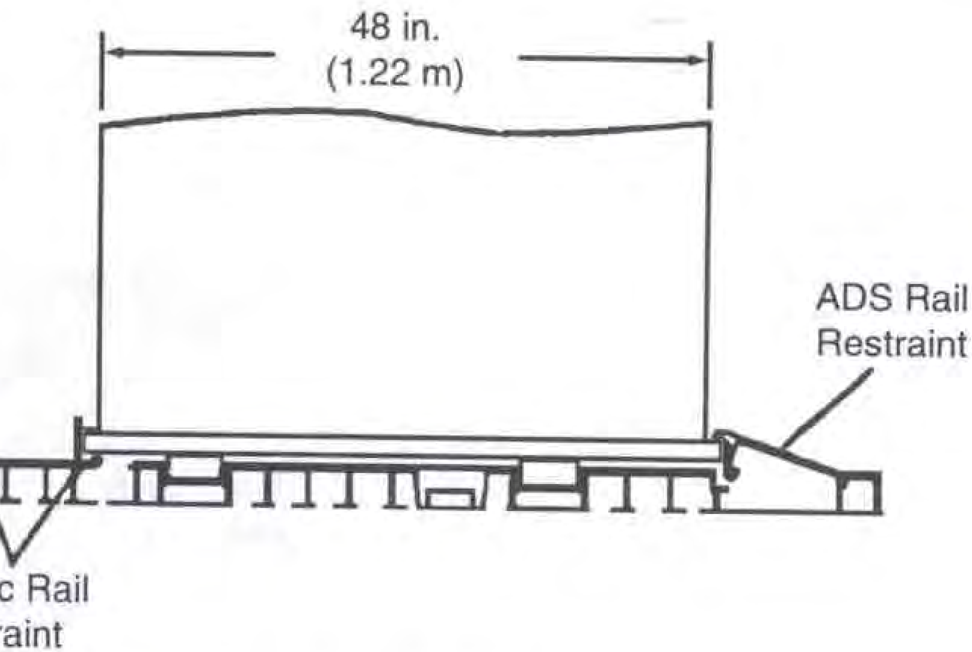


Area Dominator Based Gateway (2)

Delivery Palette / Storage Container

48” Wide, 48” High, 48” Deep
Missile Weight: 2,100 lbs
Frame & Chute Weight: 230 lbs
Power Shoe or Battery: 8 lbs
Total Weight 2,338 lbs
Spin up & download time: 300 sec

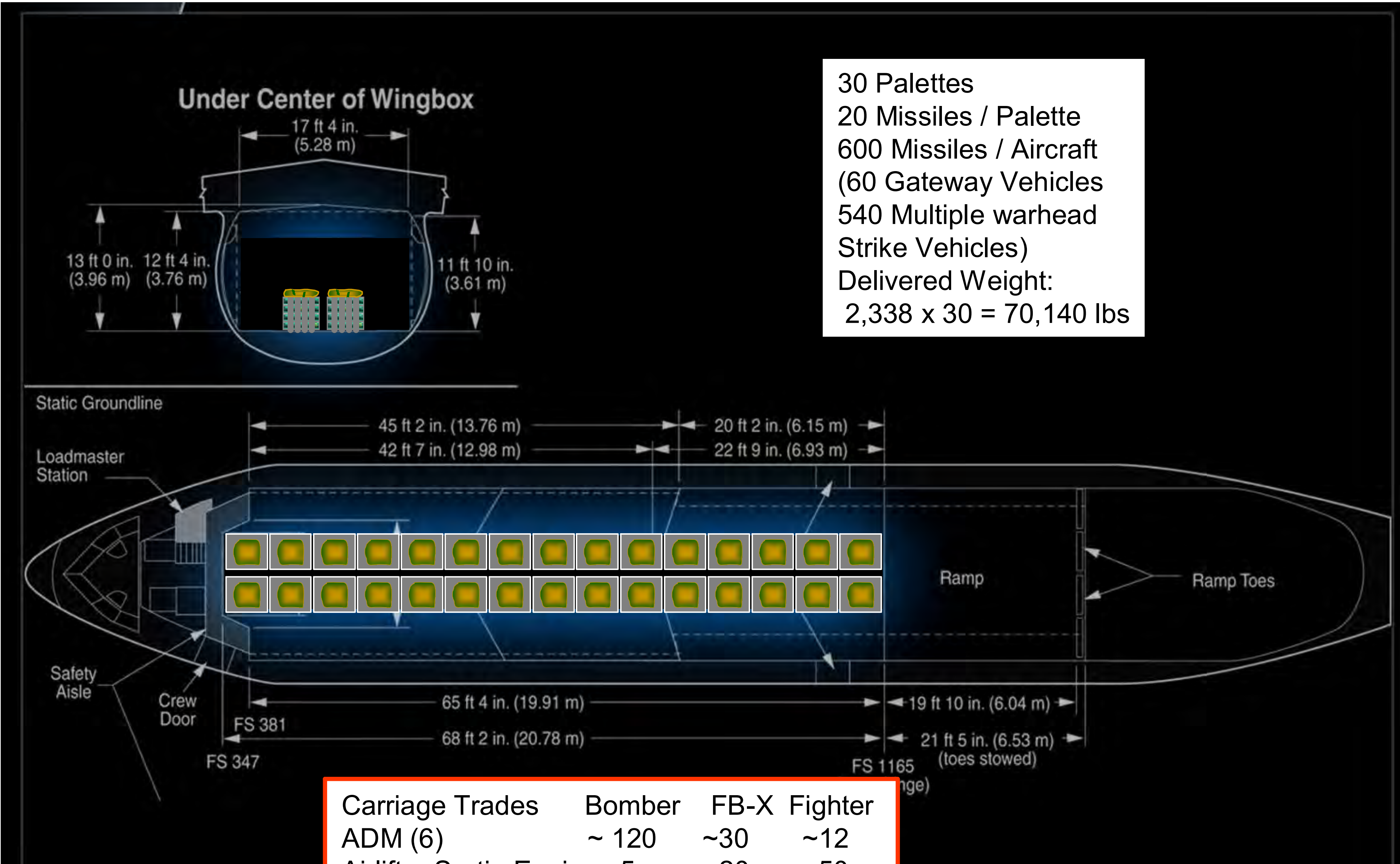




Rail Configuration for Container Delivery System Restraint

Example Large Airlifter LE-NCW Potential Loadouts

Long Endurance- Network Centric Weapons can exploit JITSA delivery capabilities



30 Palettes
20 Missiles / Palette
600 Missiles / Aircraft
(60 Gateway Vehicles
540 Multiple warhead
Strike Vehicles)
Delivered Weight:
2,338 x 30 = 70,140 lbs

Carriage Trades	Bomber	FB-X	Fighter
ADM (6)	~ 120	~30	~12
Airlifter Sortie Equiv	5	20	50

Weapon System Operator (WSO)

- **Rules Of Engagement (ROE) responsibility**
- **Manages Array of Weapons delivered by JITSA platforms**
- **Control releasable to forward ROE capable agents**
  - **Support CAS and Urban Environments**
  - **Support Special Tactics Forces**
- **Potential for Free Personnel Resources**
  - **Create Combat WSO UTC to support AEF rotations**
  - **Fill with AFMC UTC personnel (No new personnel required)**
  - **PC based training and certification**
- **Roll-on Roll-off WSO support system**
  - **Maximum exploitation of COTS equipment**
  - **Aircraft Based Communication interfaces & Environmental protection**
  - **WSOs potentially onboard MC, KC, BC and AC aircraft or in CAOC**

- Control Station NOT rigid or expensive
- Flexible Software essential
- Common JTRS radios for weapon LAN

Weapon Launch Operator (WLO)

- Airlifter Loadmaster Responsibilities
  - All Cargo Deck Operations
  - Container Delivery System Operations
- Airlifter Crewmember or Potential AFMC Crew Augmentee
  - Manages Contained Pre-launch activities
    - Weapon Power up
    - Weapon Transfer Alignment
    - Weapon BIT
    - Weapon Mission Load Verification
    - Weapon Launch and Release Envelop Advisor
    - Re-targeting Data loader
  - Resourced from AFMC resources on AEF UTC rotation
    - Control Station NOT ridge or expensive – like Rental Car turn in terminal with GPS for Transfer Alignment
    - Virtual Umbilical Controller
    - Flexible Software essential
    - Common JTRS radios for weapon LAN

Stability and Protection Operations

- Ground launch and recovery operations
  - Proven technology
  - Couples 24/7 PISR with immediate Low Collateral Damage Lethality
  - WSO services can be provided by AF personnel or chopped to Stability &Protection forces on demand
- Tactical Airlifter based operations
  - Launch services similar to other

  Airlifter deliveries can be user specified or individually launched
  - WLO/WSO services can

  remain with delivery platform
  - Two Tier cueing capability teamed with a system like RQ-1 using GMTI SAR reduces on-orbit array quantity

Summary

- JITSA can be a back breaker to large scale enemy operations
- Efficient use of force structure in large scale, stability and protection operations
- Not platform dependent
  - No Integration Costs
  - Shorter Time to Warfighter
- Potential near term DOTMLPF solution to current TCT and PISR needs

746 Test Squadron

Innovate, Execute, Excel

A NEW TEST CAPABILITY
SAASM - Integrated System Evaluator and Reporter (SAASM-ISER)

19 Oct 05

Jim Killian
746 Test Squadron

Integrity - Service - Excellence - Agility

Overview

- Background
  - What is SAASM (for those unfamiliar)
- Motivation for the New Test Capability
  - Problem; Testing shortfall
  - Proposed Solution
  - SAASM-ISER Concept
- HIMARS Checkout, proof of concept
- Schedule
- Conduct Activity
- Future Plans
- Summary

Background

- GPS is critical to precision employment
- What is SAASM GPS
  - SA = Selective Availability,
  - ASM = Anti-Spoofing Module
  - New generation GPS Security Architecture
  - Same Accuracy Performance
  - More Capability
  - Securer Military Operations

Background

- **What does the user get out of it?**
  - **Unclassified keys:**
    - **This allows the receiver to remain unclassified even after keying.**
  - **Over-The-Air Re-keying (OTAR) capability:**
    - **This simplifies key distribution, storage, expiration and disposal issues and helps to maintain Precise Positioning Service (PPS) for isolated terminals.**

Background

- **What's the user get? (continued)**
  - **Hardware:**
    - **Can be designed and fielded to be unclassified, eliminating a host of logistic complexities.**
  - **Added capability:**
    - **Allows the receiver to more easily acquire the P(Y)-code "direct", without the usual C/A to P(Y)-code sequence.**

Background

- **CJCS Master PNT Plan; CJCSI 6130.01C-E3a**
  - ***"SAASM is the 'next generation' of GPS cryptography and UE developed to decrease GPS vulnerabilities and implement new capabilities. "***
  - ***"All newly fielded DOD systems will use SAASM compliant PPS devices no later than 1 Oct 06 for the Army, Navy, Air Force, and Marines*****."** **(**without an ASD/C3I waiver**).**

Background

- **CJCS Master PNT Plan; CJCSI 6130.01C – E3b:**
  - **"*SAASM implements the Joint Staff and NSA requirement to transition the US (and its allies) from classified red keys to unclassified black keys as soon as possible*"**
  - **"*SAASM delivers black keys, improved anti-tamper, and new "Over the Air" capabilities*."**

Two Example GPS Receivers

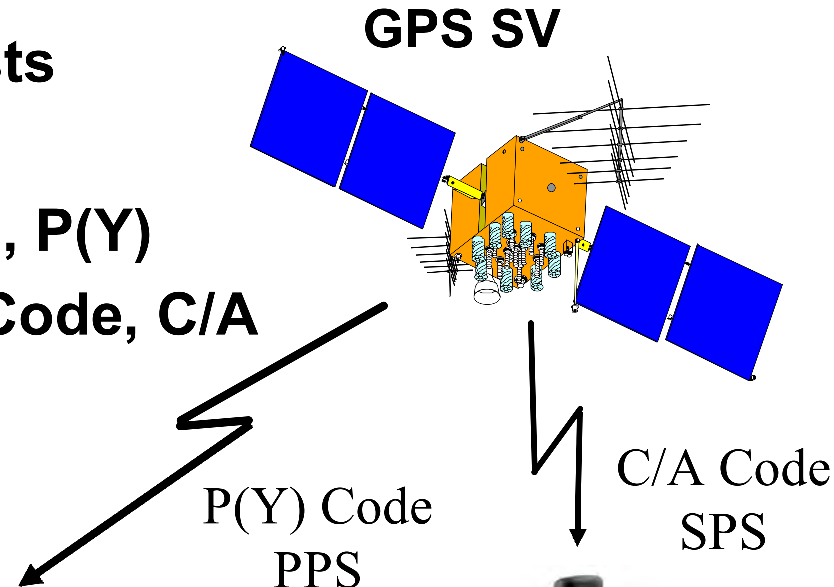
- **PLGRS**
  - Non SAASM

- **DAGR**
  - SAASM

  - Unclassified Keys
  - OTAR
  - Direct Y code enabler

GPS = TWO Signals

- Note: Each SV broadcasts TWO signals:
  - Military Precise Code, P(Y)
  - Civilian Coarse Acq Code, C/A



MILITARY

CIVILIAN

Why a New Test Capability

- **Shortfall in Testing Integrated Systems**
  - No SAASM Signal in Space (SIS) yet
  - No standard method in place to verify integrated system level functional integrity
  - SAASM GPS testing done at GPS receiver Host Application Equipment (HAE) level

Why a New Test Capability?

- Possible Consequences of Shortfall
  - Find 'glitches' during real-world operations
  - Disruption of ops., limfacts, friction of war

- Innovated Solution – SAASM-ISER
  - Simulated SIS to test Over-the-Air functions
  - Test anywhere, anytime, on FMC platforms
  - Virtually no 'down-time' on aircraft/platform

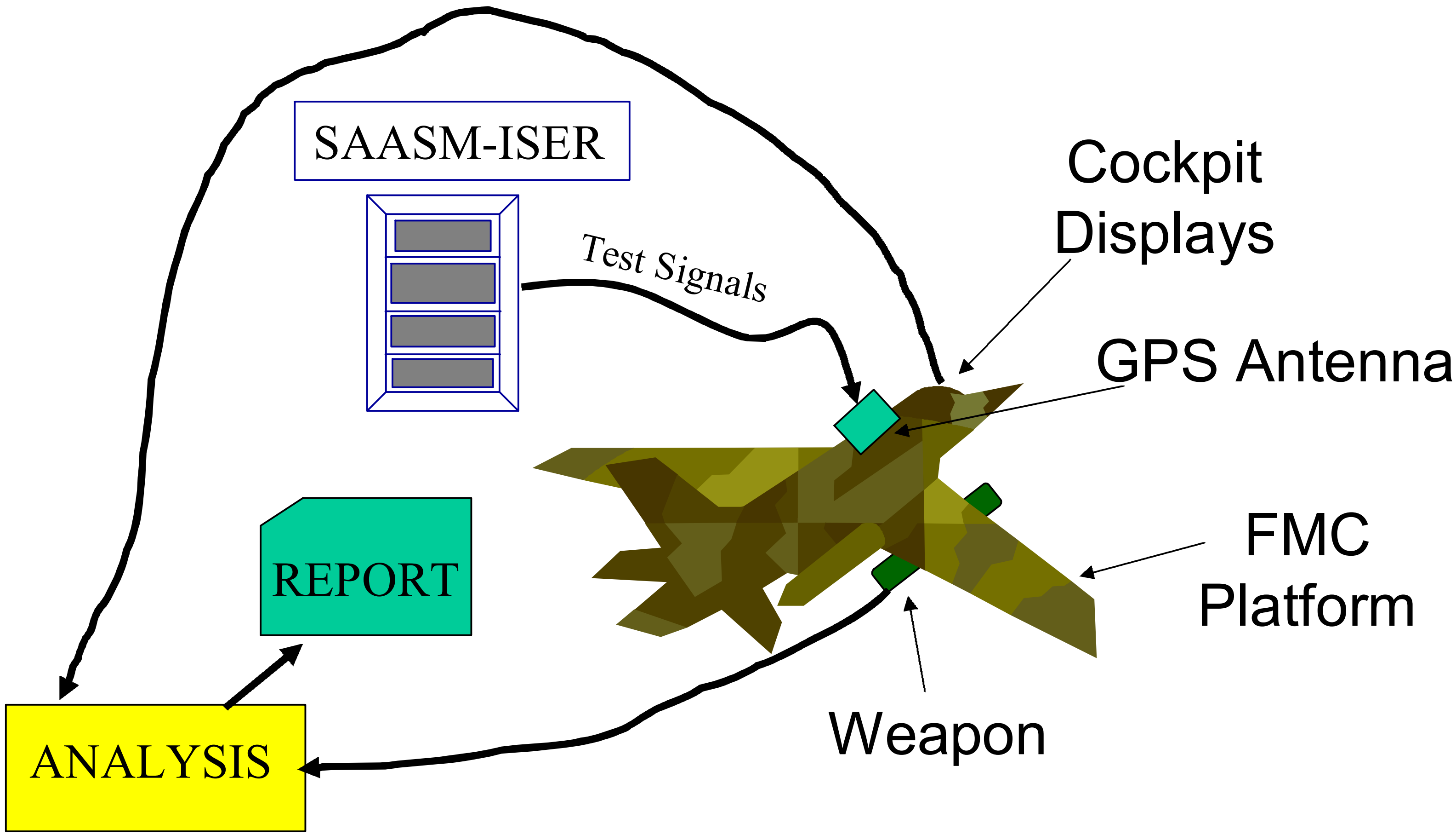
Proposed Solution

- **SAASM Integrated System Evaluator and Reporter (SAASM-ISER)**
  - Cost effective solution for verifying SAASM end-to-end Performance
  - Mobile Test Capability;
    - Palletized Simulator
    - Provides signals not yet available from satellites

Proposed Solution (cont)

- SAASM Integrated System Evaluator and Reporter (SAASM-ISER)
  - Ability to broadcast GPS and SAASM scenarios directly into platform antenna
    - Especially useful for systems passing information from a GPS receiver to another piece of equipment
  - Real-time assessment via cockpit displays & data collected from receiver instrumentation port or bus
    - Verifies integrated navigation system functionality

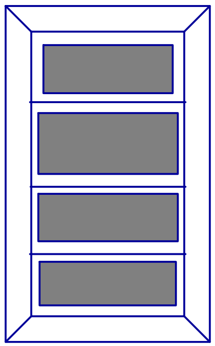
SAASM-ISER Concept



Location = anywhere

Flow of Test Signal

Palletized
SAASM-ISER



Antenna Hood, RF Link

Defense Adv
GPS Receiver
(DAGR)

Baseline Reference Simultaneously Run for Quality Control Monitor of signal simulation

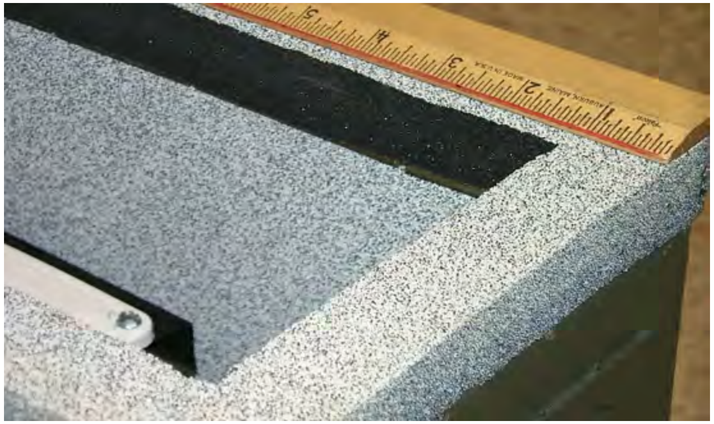
Typical Integrated Navigation / Weapon System Under Test

Active Antenna Hood

Adjustable FRPA Radiates Internally

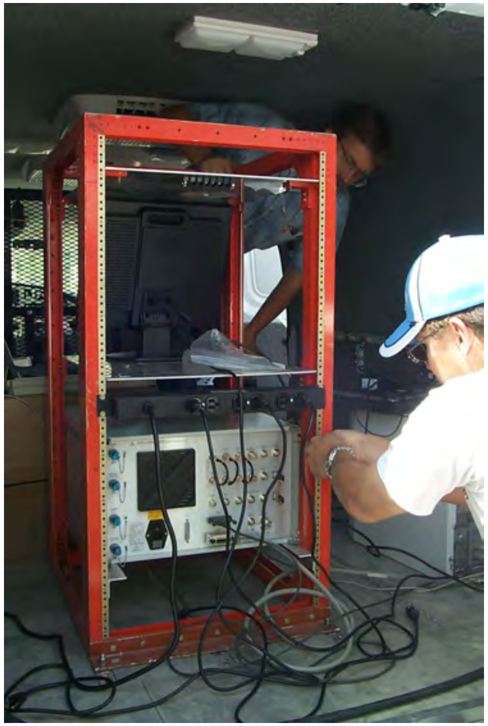
Dimension: 7x17x14 inches

Interior RAM



SAASM-ISER Van

- Van Equipped with:
  - Full elec power cap
  - Pallet ties
  - Environment control

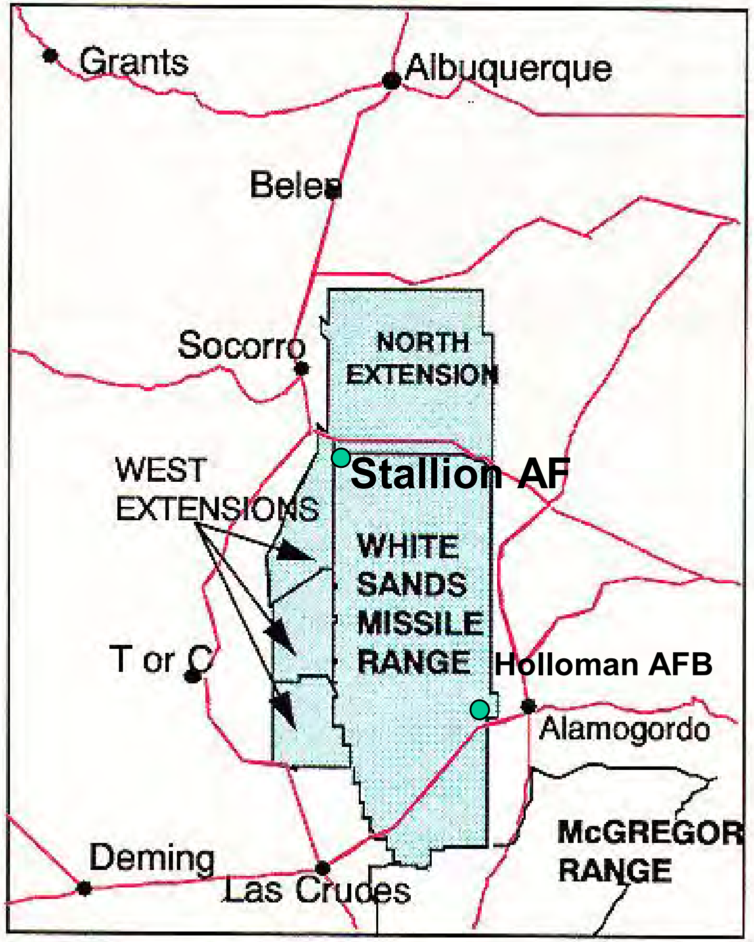


-Advertised availability: Summer 2005

-Army HIMARS requested to be SAASM-ISEd in May 2005

SAASM-ISER MOBILIZED

- Traveled to the "land of the **ORYX"** for the first remote SAASM-ISER test
- Location: WSMR, Stallion Air Field



HIMARS Checkout & Proof of Concept

- **First Customer: HIMARS**
  - At WSMR for JAMFEST in May 05
  - Extended 1 week for SAASM-ISER Testing

High Mobility Artillery Rocket System (HIMARS)

FRPA-3 mounts on the top rear of the right side sponson

"Excellence Through Innovation"

Schedule

- 2 March – Program introduction; HIMARS requests SAASM-ISER test
- 18 March – Developed requirements
- 20 April – Finalized development process
- 16 May – Completed development of SAASM-ISER for HIMARS readiness
- 18 May – Pre-checkout survey of HIMARS
- 21 May – JAMFEST completed
- 23 May – Mobilized to Stallion Air Field and Marshaled equipment with HIMARS
- 24-25 May – Conducted SAASM-ISER scenarios

HIMARS Weapon System

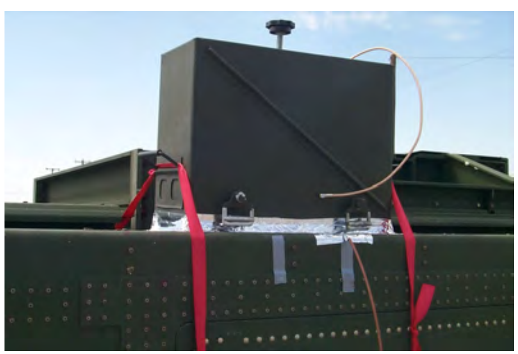
HIMARS Integrated Navigation Systems

- CONSISTS OF THREE SYSTEMS INTEGRATED
  - Fire control system
  - Position / navigation system (GPS / INS)
  - Launcher weapon system (GPS / INS)

SAASM-ISER Test Conduct

-HIMARS FRPA on right launcher sponson

- Co-located FRPA for DAGR under hood for baseline monitoring and quality control of SAASM-ISER scenarios



- Hood tested for leakage of simulated signals in and out, in lab and on the HIMARS
- Added shielding tape to edged of hood to block all signal

SAASM-ISER to HIMARS Hookup

- Hood strapped to sponson

- Coax leads run from Hood FRPA, DAGR FRPA, and system data-feed

- All cables fed through cable access door in van

"Excellence Through Innovation"

SAASM-ISER Control Station

- Computer controlled and monitored
- Dual AC; Insulated
- Temp during Test:

Outside = 102F

Inside = 65F

Laptop monitors for:

- Simulator
- DAGR Baseline
- Test Item

“Excellence Through Innovation”

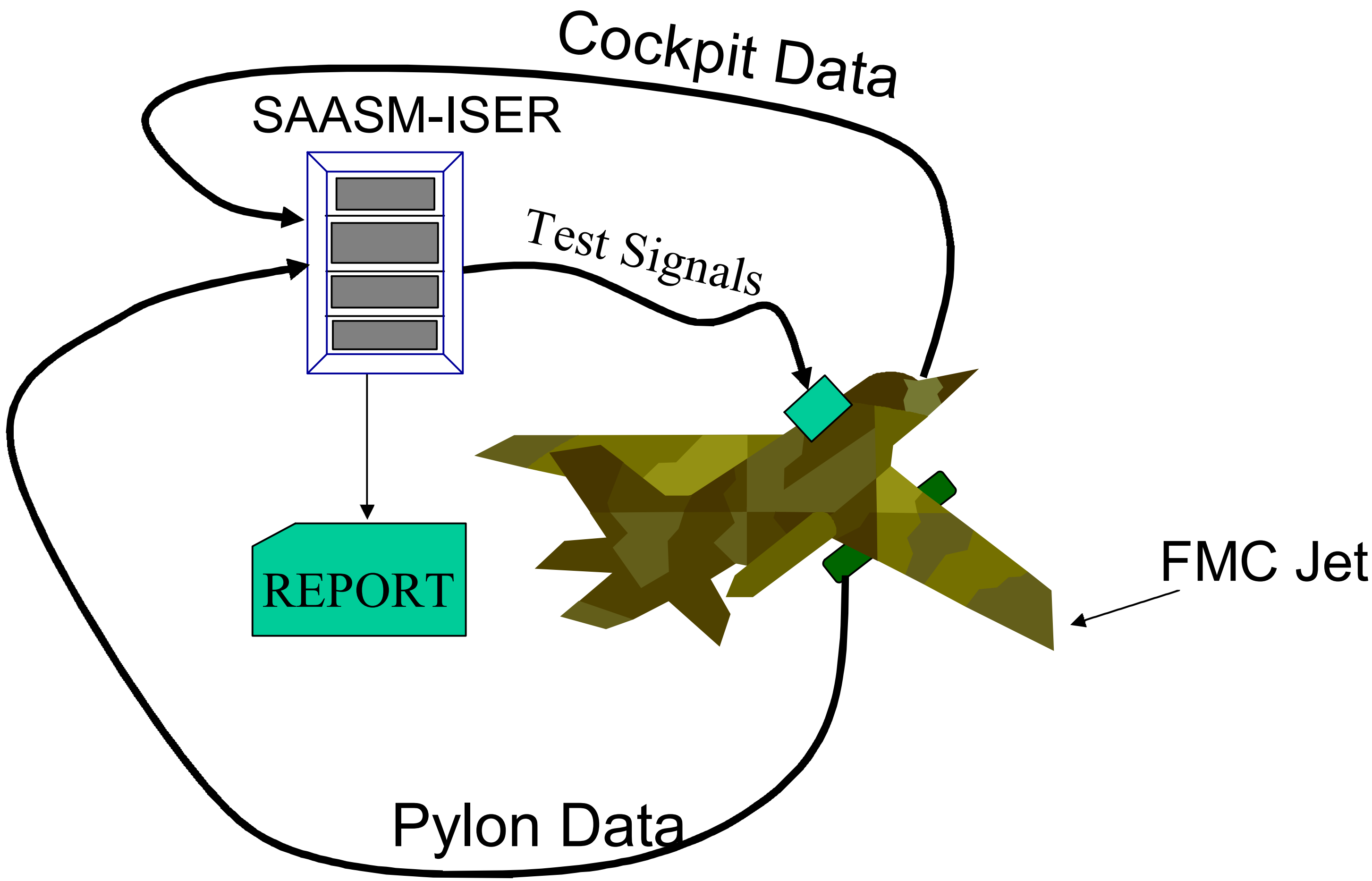
Test Result

- **HIMARS TEST:**
  - Accomplished each of planned tests
  - Provided customer with results
  - Customer very pleased with success of tests and information obtained

Future Plans

- Create a larger hood adequate for larger antennas
  – Controlled Reception Pattern Antenna (CRPA)
- Refine test procedures
- Automate sequence of tests desired
- Provide automated End-of-Checkout Report from SAASM-ISER
- Support anomaly resolution

Automated SAASM-ISER



Summary

- SAASM-ISER
  - Provides a government test tool to test end-to-end Integrated SAASM GPS systems
  - Verifies the functional integrity of integrated navigation and weapons system on an FMC platform incorporating SAASM GPS
  - No re-configuration of FMC platform necessary
  - Provides means to investigate anomalies
  - Mobile, and can travel where needed
  - Demonstrated proof of capability on HIMARS

Questions?

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DSN: 349-2600

Com: 505-679-2600

ACRONYMS

- SAASM: Selective Availability Anti Spoofing Module
- SIS: Signal in Space
- OTAR: Over The Air Re-key
- P(Y): Precision Code, Encrypted
- C/A: Coarse Acquisition Code
- RF: Radio Frequency
- DAGR: Defense Advanced GPS Receiver
- CRPA: Controlled Reception Pattern Antenna
- FRPA: Fixed Reception Pattern Antenna

Department of Defense:

Assistant to the Secretary of Defense Nuclear and Chemical and Biological Defense Programs (ATSD(NCB))

Dr. Dale Klein

Briefing for Precision Strike Community
October 20, 2005

Global War on Terror

"Today, the gravest danger in the war on terror, the gravest danger facing America and the world, is outlaw regimes that seek and possess nuclear, chemical, and biological weapons. These regimes could use such weapons for blackmail, terror, and mass murder. They could also give or sell those weapons to terrorist allies, who would use them without the least hesitation."

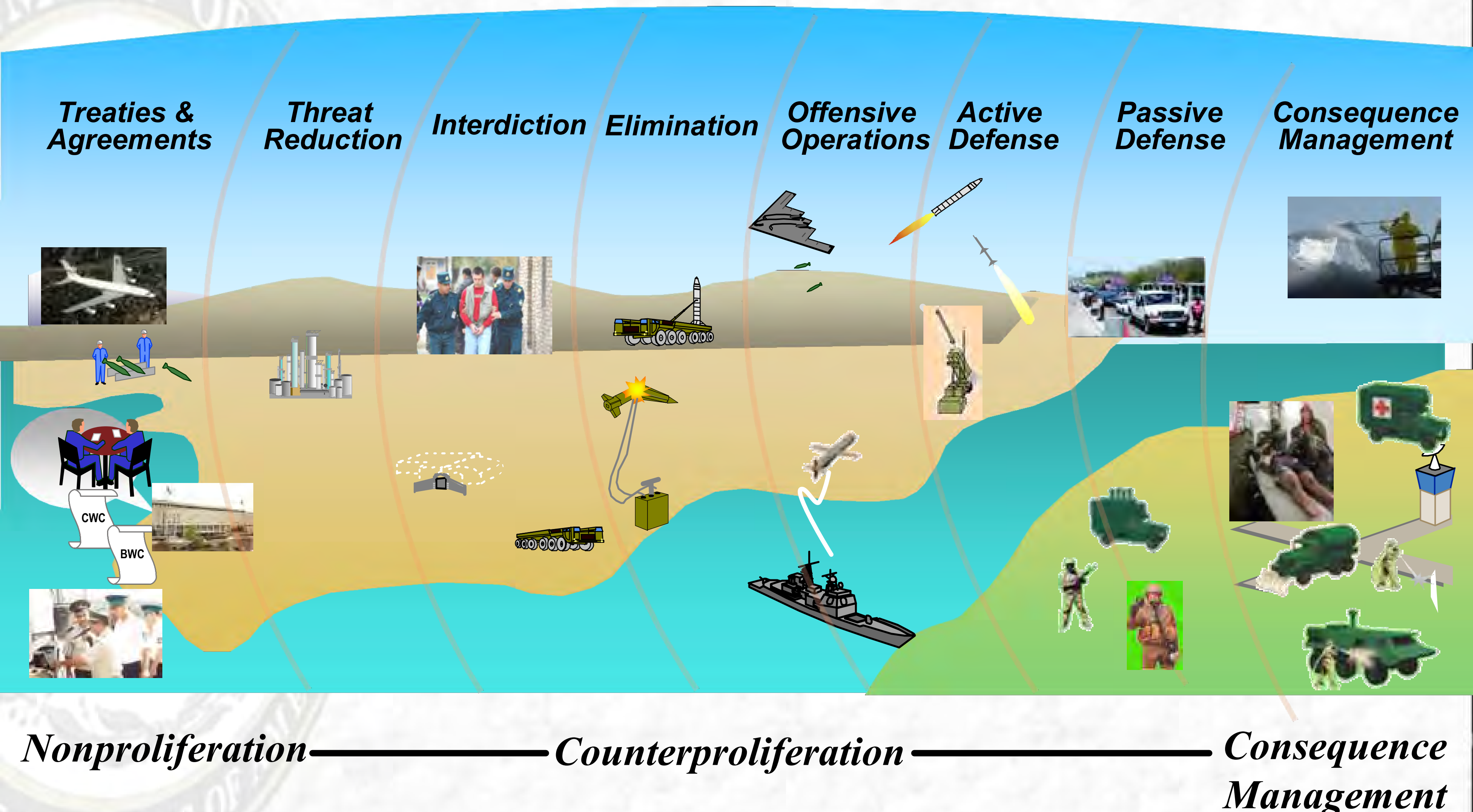
- President George W. Bush,
2003 State of the Union

Combating WMD Strategy Guidance

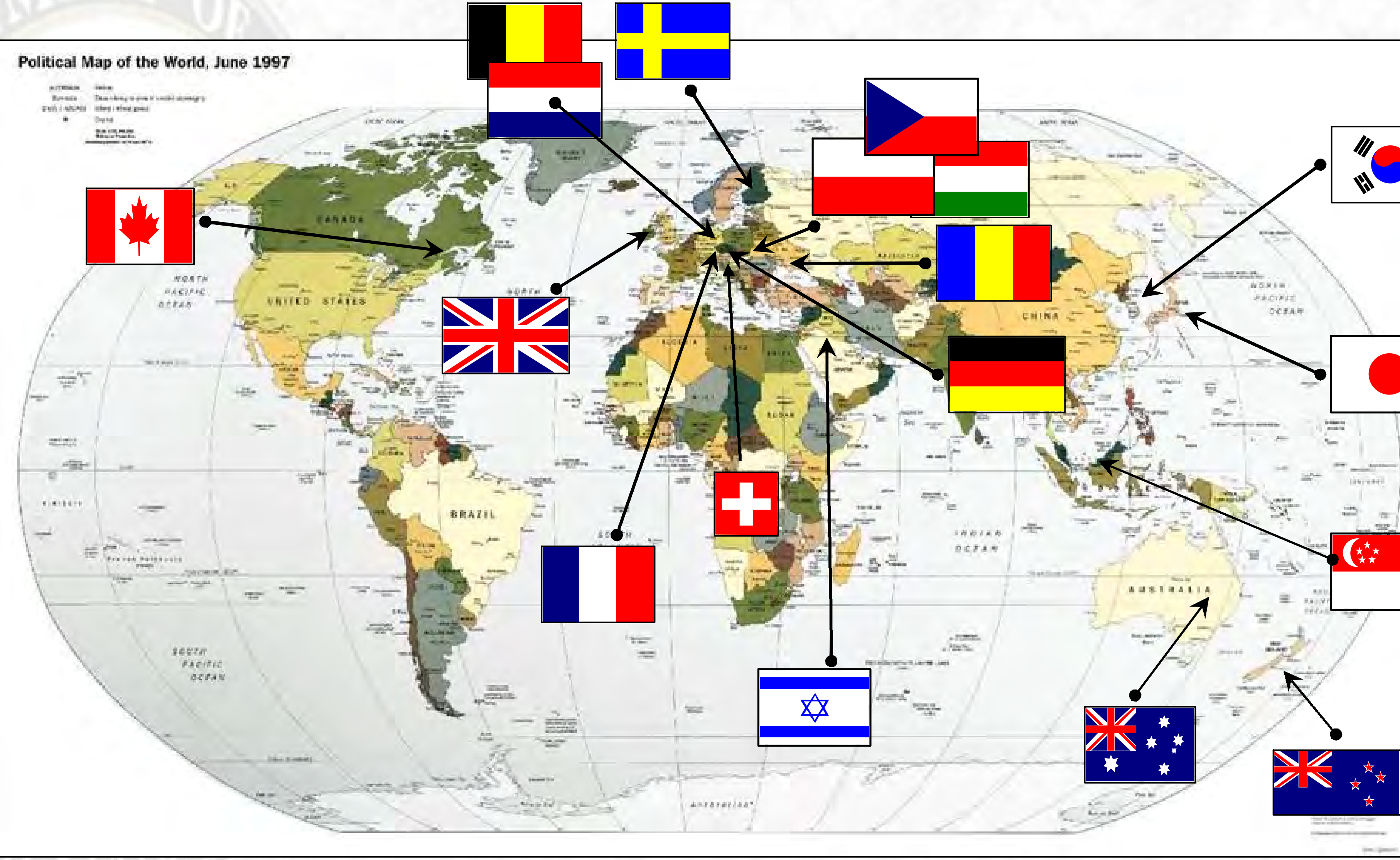
- **Under the overall umbrella of the *National Security Strategy***
- **Consider in relation to other National Strategies, especially:**
  - ***Homeland Security***
  - ***Combating Terrorism***
  - **Intersecting strategies:**
    - ***Critical Infrastructure Protection***
    - ***Secure Cyberspace***
    - ***Counterintelligence***
    - ***Biodefense for the 21st Century***

Combating WMD Strategy

These 3 pillars provide for a layered defense across 8 mission areas



Worldwide Cooperation in Combating WMD

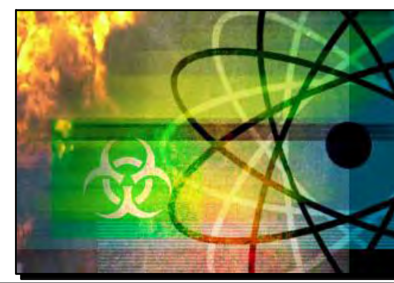


Leveraging Other WMD Developmental Efforts

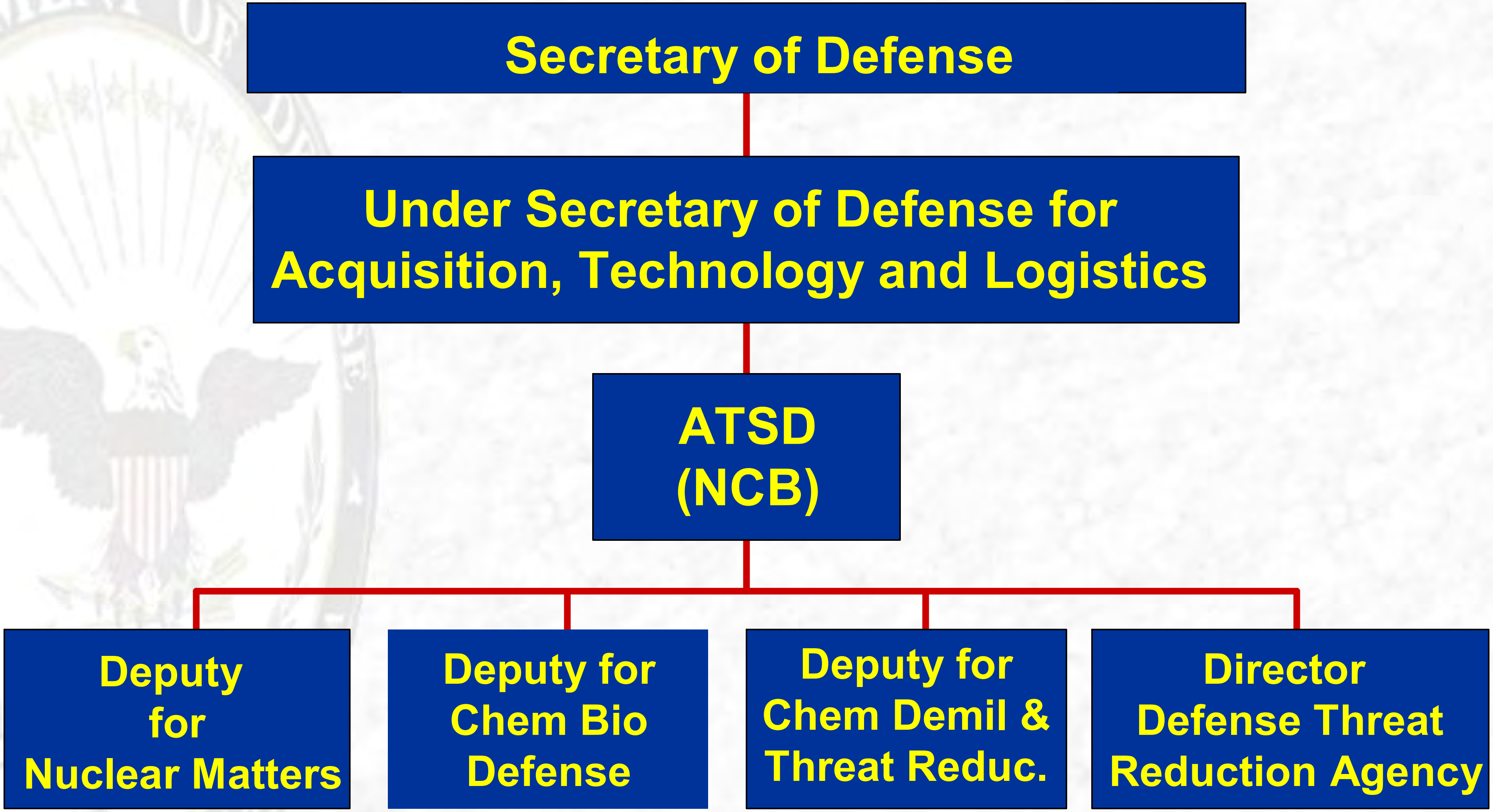
- **Semiconductor Ultra Violet Optical Sources (SUVOS) Program**
- **Immune Building**
- **Pentagon Shield**

- **BIONET**
- **DHS/EPA/DOD Building Decontamination**

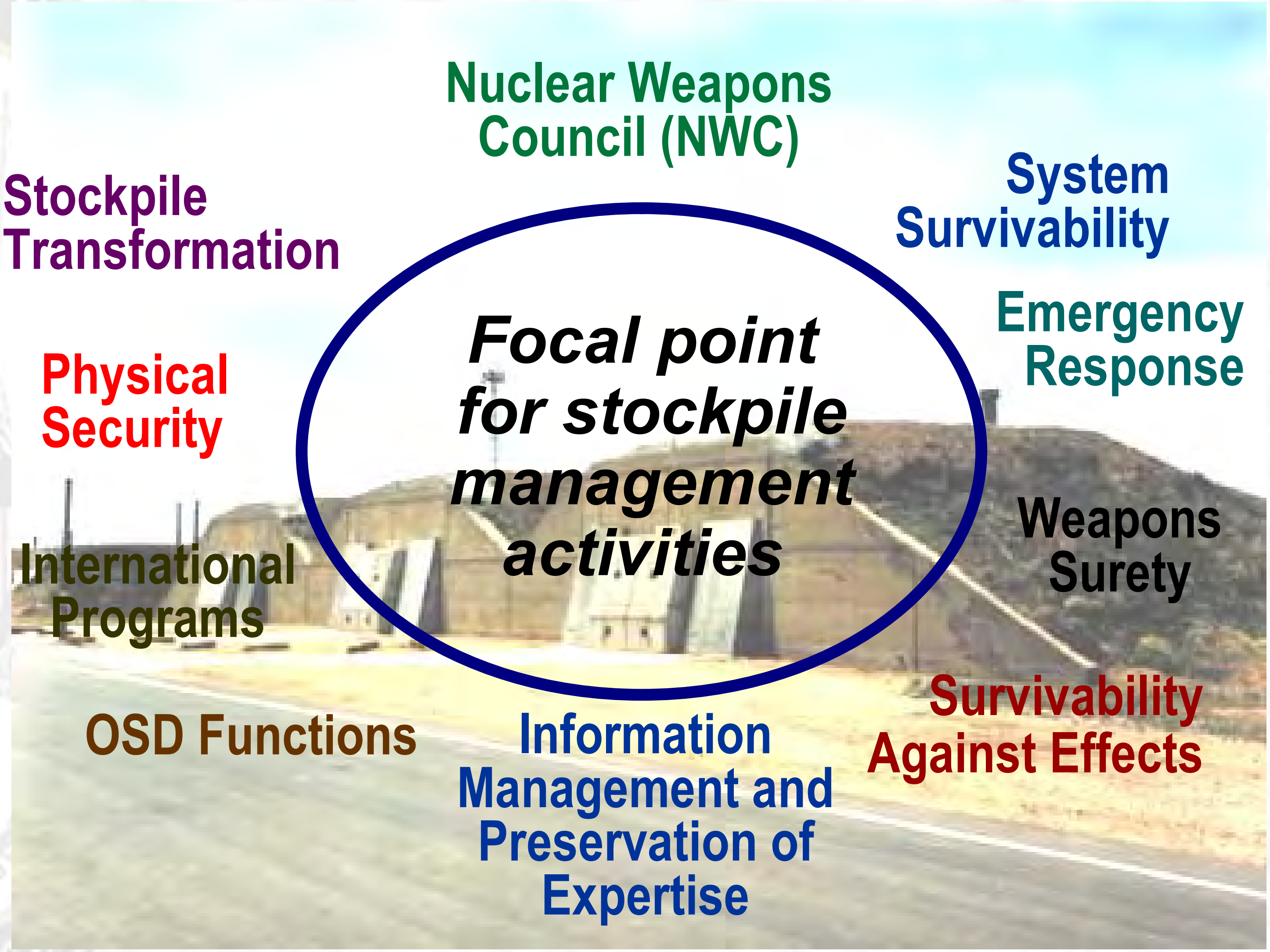
COMMERCIAL INVESTMENTS



ATSD (NCB) Organization

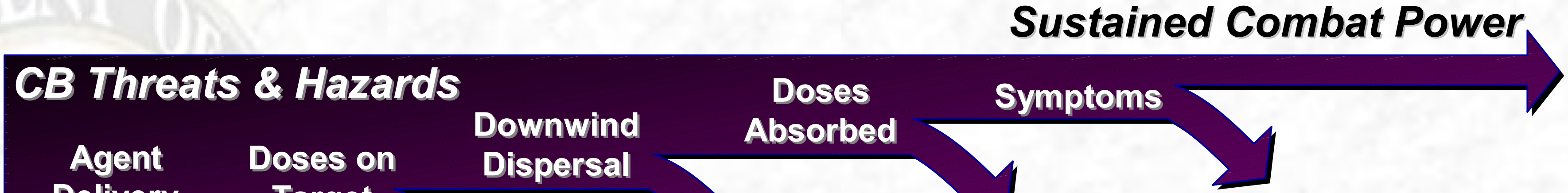


Office of Nuclear Matters (NM)



Chemical and Biological Defense Program

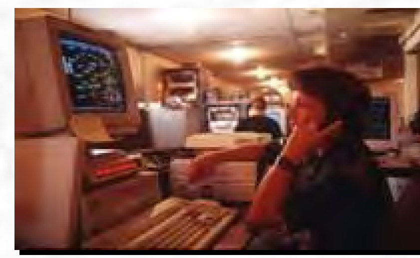
System of Systems Approach to Counter the Threat



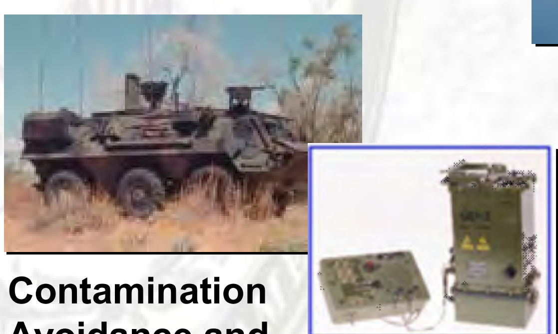
Medical Pretreatment

Individual & Collective Protection

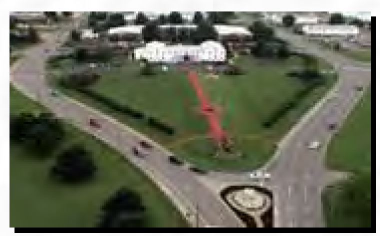
Medical Treatment



Information Systems



Contamination Avoidance and NBC Battle Management



Installation Force Protection

Decontamination and Restoration

Chemical Demilitarization &Threat Reduction (CDTR) Mission

- **Oversight of Chem-Demil, Cooperative Threat Reduction, and CB Weapons Treaties**
- **DoD Treaty Manager for NBC Weapons Treaties**
    - **NTBT, NPT/IAEA Strengthened Safeguards Protocol, FMCT, CWC, BWC**
- **Program Coordination**

Tooele Chemical Agent Disposal Facility (TOCDF)

Defense Threat Reduction Agency (DTRA)

Mission

Safeguard America and its allies from Weapons of Mass Destruction by providing capabilities to reduce, eliminate and counter the threat and mitigate its effects.

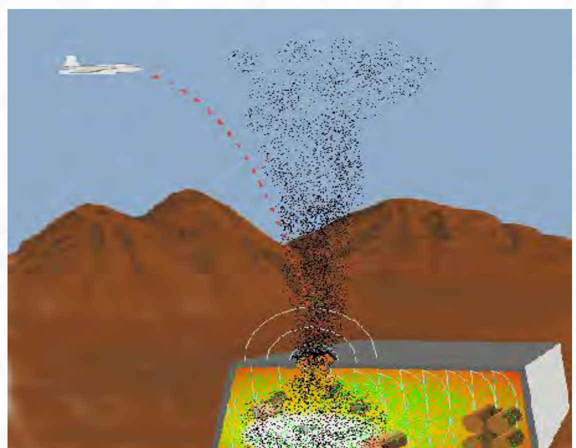
Combat Support Role

DTRA's role as a combat support agency is to provide combating WMD capabilities to support the Joint Staff and Combatant Commands.

ATSD (NCB) Mission Areas

Nuclear Matters

Chemical Demilitarization



Defense Threat Reduction Agency

Chemical & Biological Defense

Countering the Risks Posed by WMD

- Detect
- Prevent
- Deter
- Destroy

Detect

Gamma Imaging System

- Non-Intrusive System to Image Inside Shipping Containers (Ships, Trucks)

- Capability to Examine Large Vehicles for Explosive Devices

"The Army, Navy and Air Force each employed Unmanned Aerial Vehicle systems in theater to conduct important reconnaissance operations, reducing the need to send manned aircraft into hostile airspace."

- Secretary of Defense, 14 October 1999

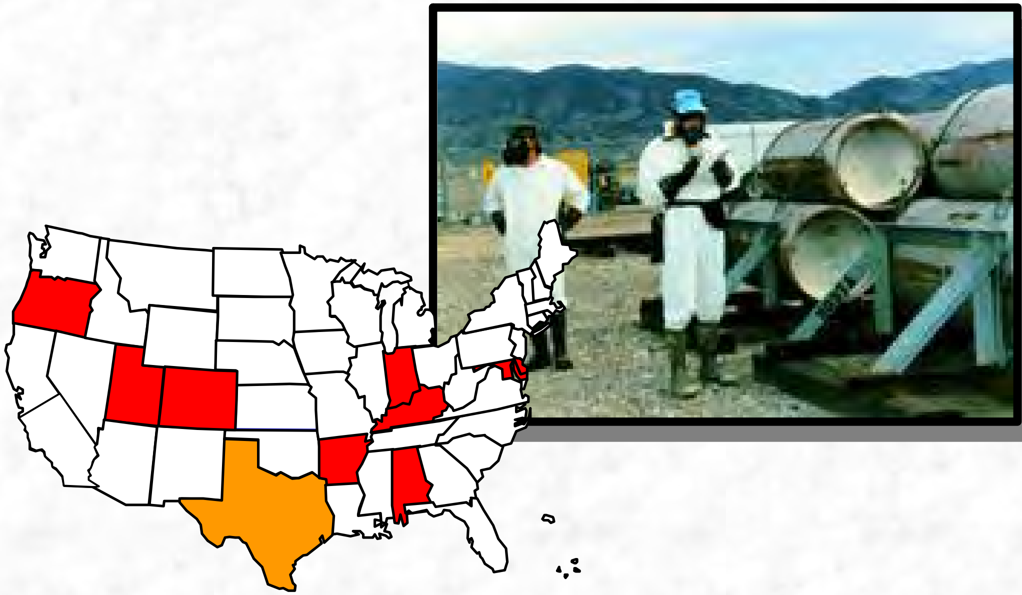
Prevent

Nuclear Arms Control

- Monitoring activities and inspections
- Dismantling stockpiled weapons

Chemical Weapons Arms Control

- Monitoring activities and inspections
- Dismantling stockpiled weapons



Deter

Stockpile Stewardship Program

- Non-nuclear component testing
- Mathematical models
- Nuclear material tests

W76-1 Blast Test at Sandia – Part of the W76-1 Lifetime Extension Program

Dual Axis Radiographic Hydrodynamic Test Facility for Hydrotesting at Los Alamos

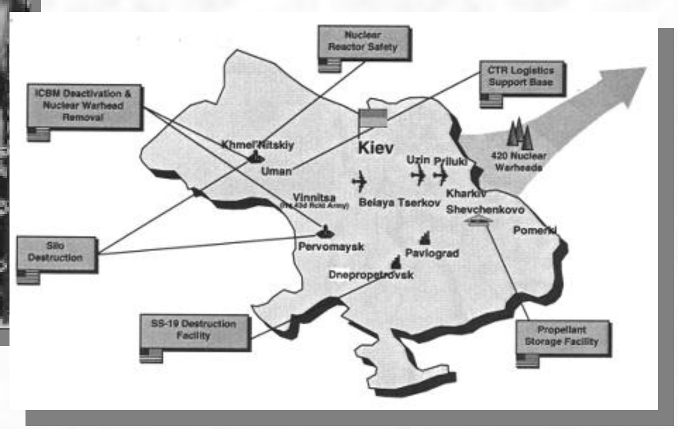
Integrated subcritical experiments at LANL's NTS U1a facility get key Plutonium data

Destroy
(Cooperative)

Cooperative Threat Reduction

- Assisting in securing nuclear material
- Preventing the use of nuclear material in weapons
- Redirecting weapons material for use in electric power generation

Secretary of Defense Perry at an SS-24 ICBM Silo, Ukraine



CTR in Ukraine

Destroy

(Cooperative)

Chemical Weapons Convention requirements

- Safely destroying all chemical weapons stockpiles

Tooele Chemical Agent Disposal Facility (TOCDF)

Destroy

(Uncooperative)

Thermobaric Weapons

- **Provide Enhanced Effects in Closed Structures: Sustained Pressure and Increased Heat**
- **Weapons currently fielded**

Issues of Interest brought to the Precision Strike Community

- **Reliable Replacement Warhead (RRW)**
- **Robust Nuclear Earth Penatrator (RNEP)**
- **Thermobaric Weapons**
- **Agent Defeat Weapons**

The Reliable Replacement Warhead (RRW)

What is it?

The RRW is the next generation of nuclear warheads to meet the defense needs of the United States.

Why is it needed?

The RRW will reduce costs of producing and maintaining nuclear warheads, broaden performance designs, utilize modern production techniques, and enhance surety.

When can this happen?

A warhead can be designed and deployed without testing in 8-10 years.

The Robust Nuclear Earth Penetrator (RNEP)

What is it?

The RNEP would be designed to destroy hard and deeply buried targets (HDBTs) such as chemical weapon storage, command and control nodes, or leadership centers.

Why is it needed?

There has been a major proliferation of HDBTs and current weaponry cannot defeat them all.

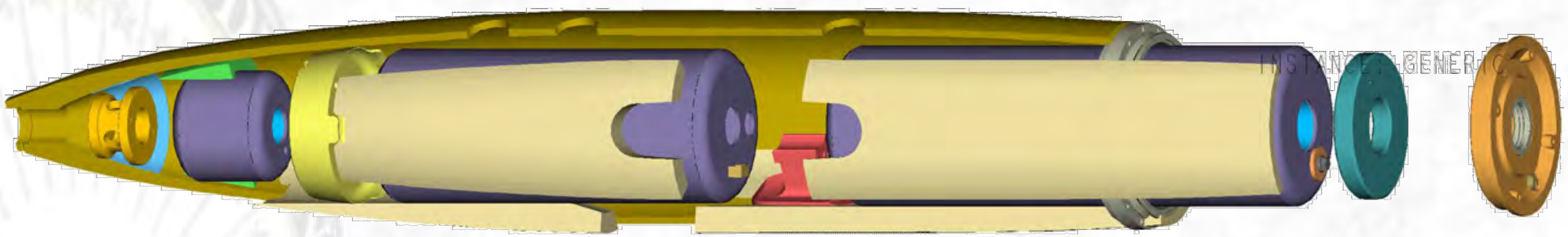
What is the status?

Funding responsibility for RNEP is spread over six Congressional committees. All have different proposals for RNEP study:

Complete funding to cancellation

Thermobaric Skip Bomb Demonstration

Agent Defeat Weapon - Incendiary



BLU-119/B (CrashPAD)

Existing MK84 Bomb body
High Explosive (PBX-109) ~ 145 lb
Agent Defeat (WP) ~ 420 lb

Summary

- **S&T investment to counter diverse threats & prevent technological surprise**
- **Capabilities to protect the warfighter**
- **Improve the precision of new and stockpiled weapons for future engagements**

"We all lust for the day when the lion and the lamb will lie down together, but when that day happens, I want to be the lion."

Questions?

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Agile Acquisition Processes For Joint Capabilities

October 18, 2005

Mike Knollmann
ADUSD
(Joint & Coalition Operations Support)
-
Office
Of
Deputy Under Secretary of Defense
(Advanced Systems & Concepts)

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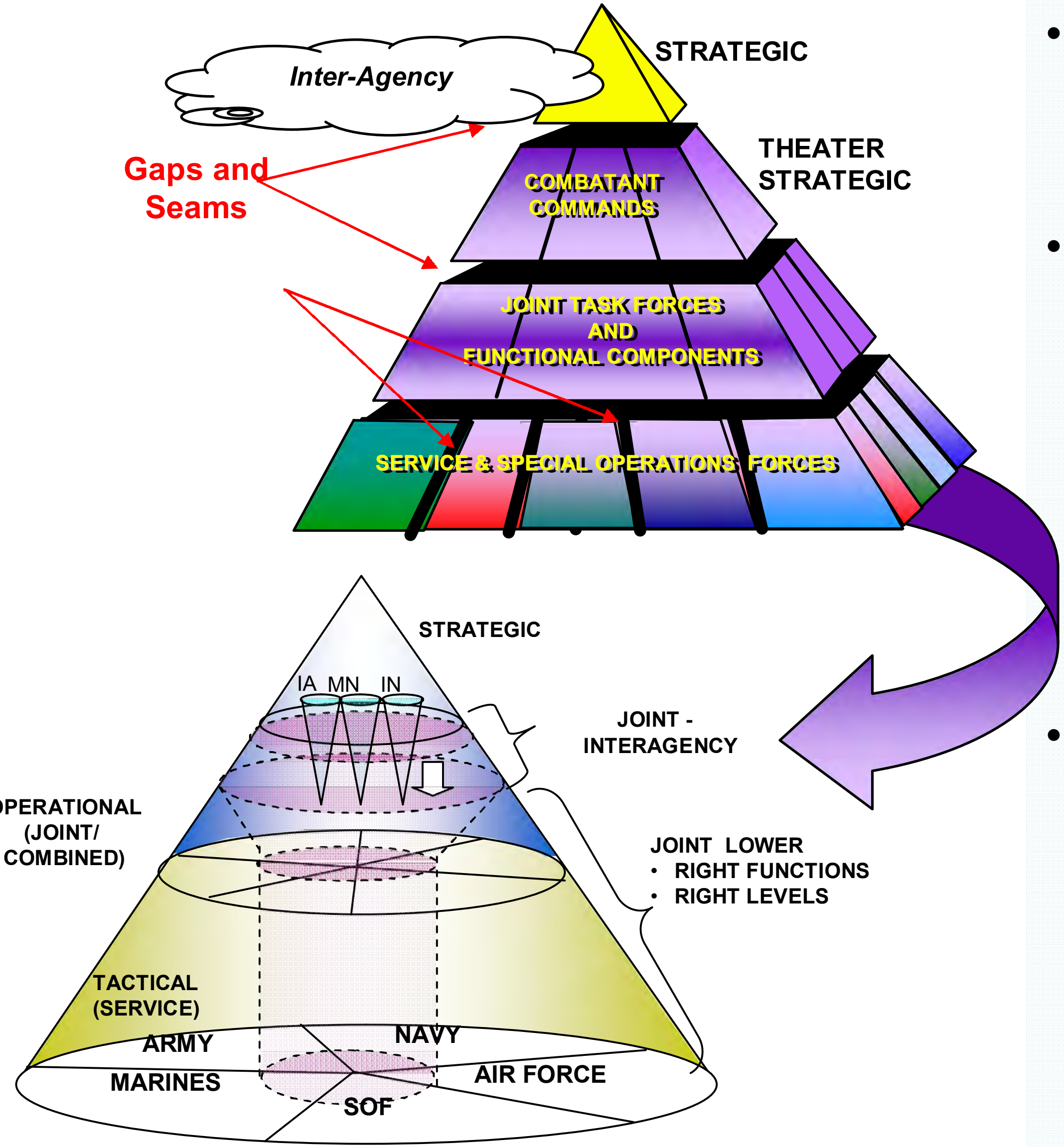
OIF Underscored Role Of Joint Capabilities



- *OIF lessons learned reinforce role of joint capabilities*
- *Joint capabilities initially limited to strategic level: integration of segregated component commander activities*
- *OIF lessons learned portrayed expanding requirements for core joint capabilities at strategic, operational and tactical levels*

What are Joint Capabilities?
Agile Acquisition Perspective

Unique Regional/Specified Mission Needs

Capabilities beyond common core military elements required by warfighters to effectively function in operational environments for joint regional or specified missions.

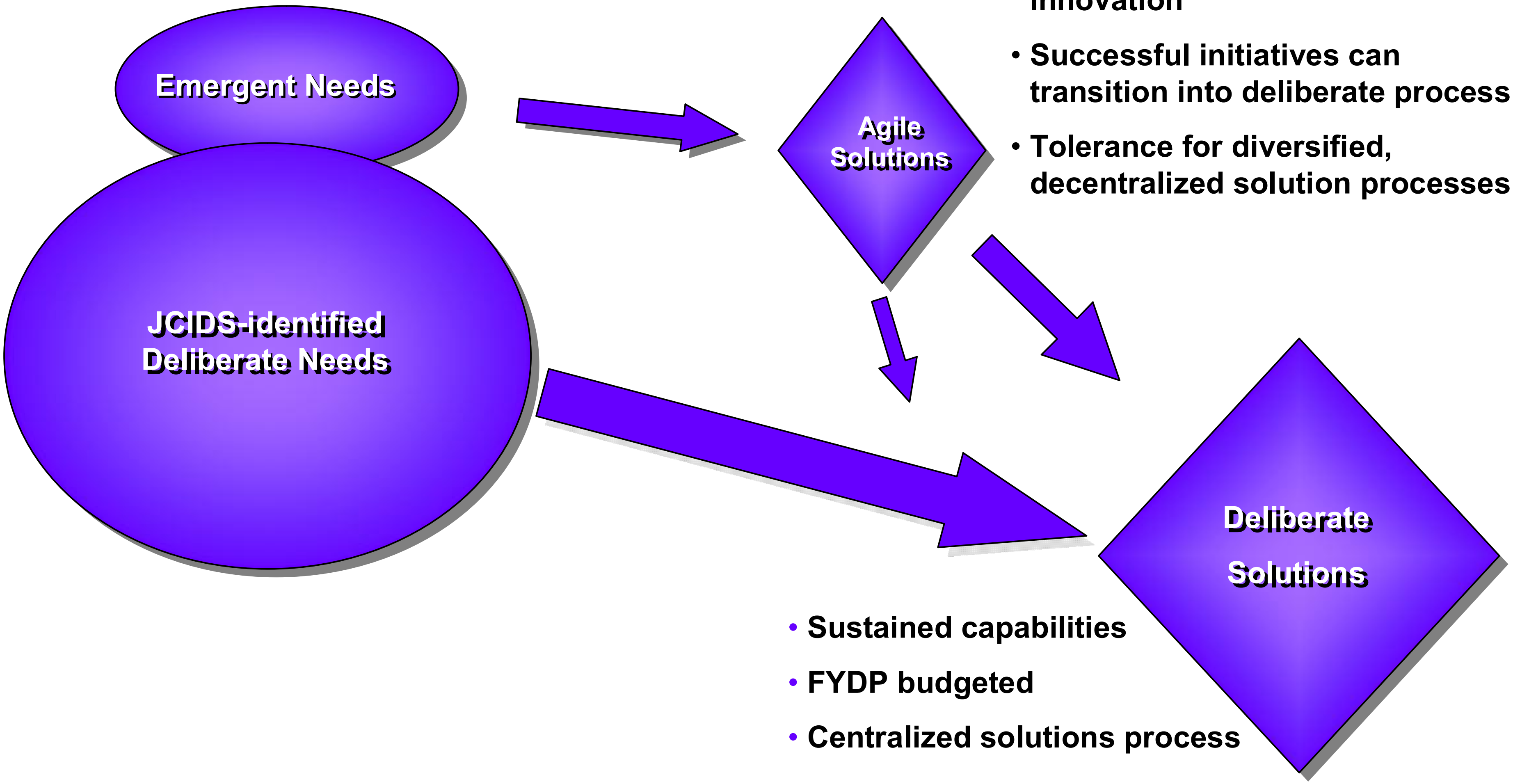
Joint Enabling Capabilities

Additional capabilities required by warfighters to exercise joint command, and to enable core military elements to function effectively as a coherent joint force.

Multi-Service Core Capabilities

Common denominator Military forces provided worldwide as self-integrated, self-sustaining echelons by the Services.

Developing Solutions for Joint Needs:
Aligning Solutions Process with Joint Realities



- Execution/Budget Year initiatives
- Engine for flexibility and innovation
- Successful initiatives can transition into deliberate process
- Tolerance for diversified, decentralized solution processes

- Sustained capabilities
- FYDP budgeted
- Centralized solutions process

Balanced Score Card Acquisition

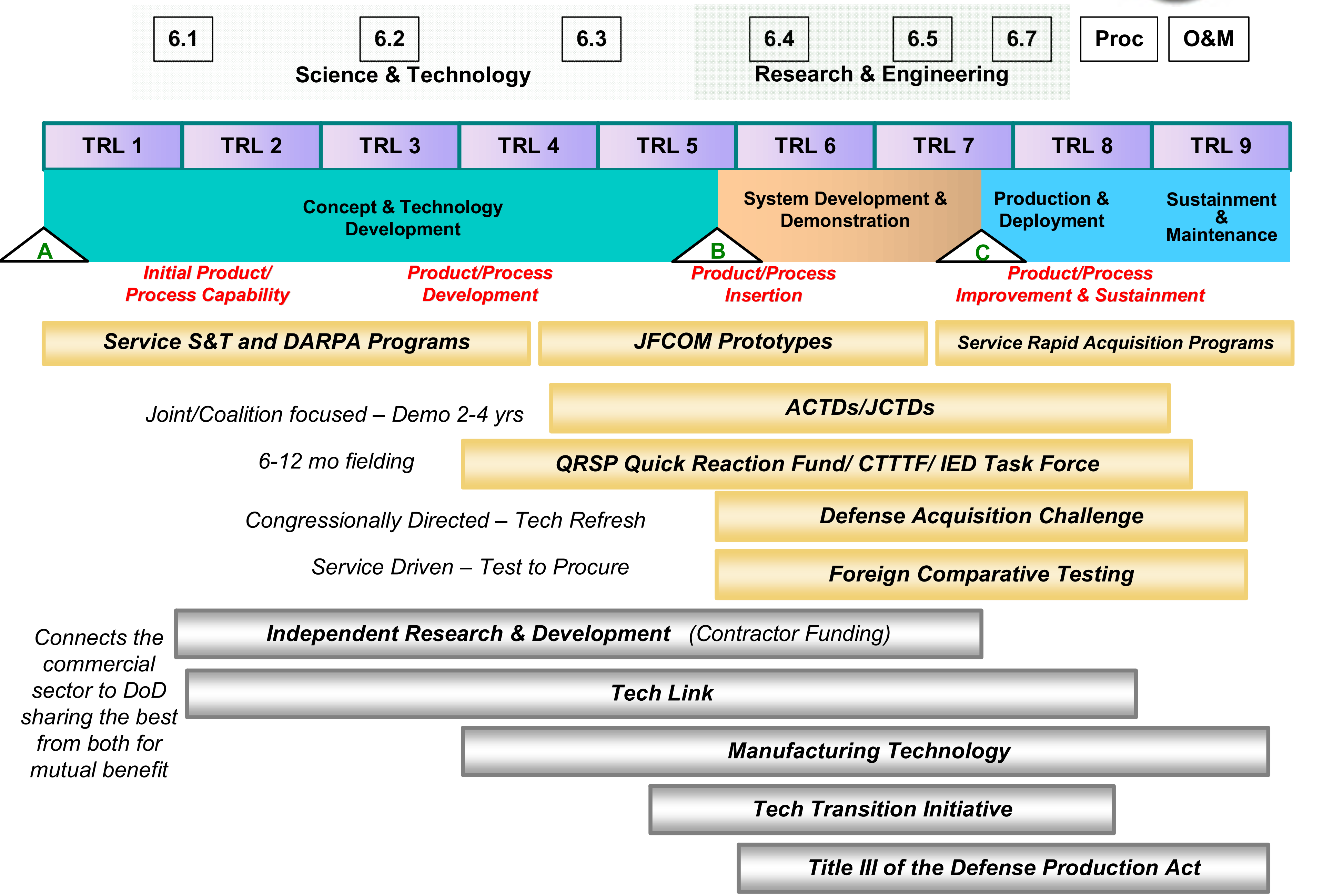
Agile Solutions

- ✓ Rapid, responsive, flexible program
- ✓ Decentralized execution
- ✓ Transformation engine; innovation enabler
- ✓ Small, non-traditional business "on-ramp"
- ✓ "Try before you buy" cost control mechanism
- ✓ Potential spiral improvement generator

- ✓ Checks & balances for accountable acquisition
- ✓ Optimized for delivery of complex systems
- ✓ Methodical oversight and synchronization
- ✓ Includes sustainment resources
- ✓ Well adapted to individual Service cultures
- ✓ Scalable for large-scale military solutions

Deliberate Solutions

Agile Acquisition Processes



RELEVANT RAPID RESPONSIVE

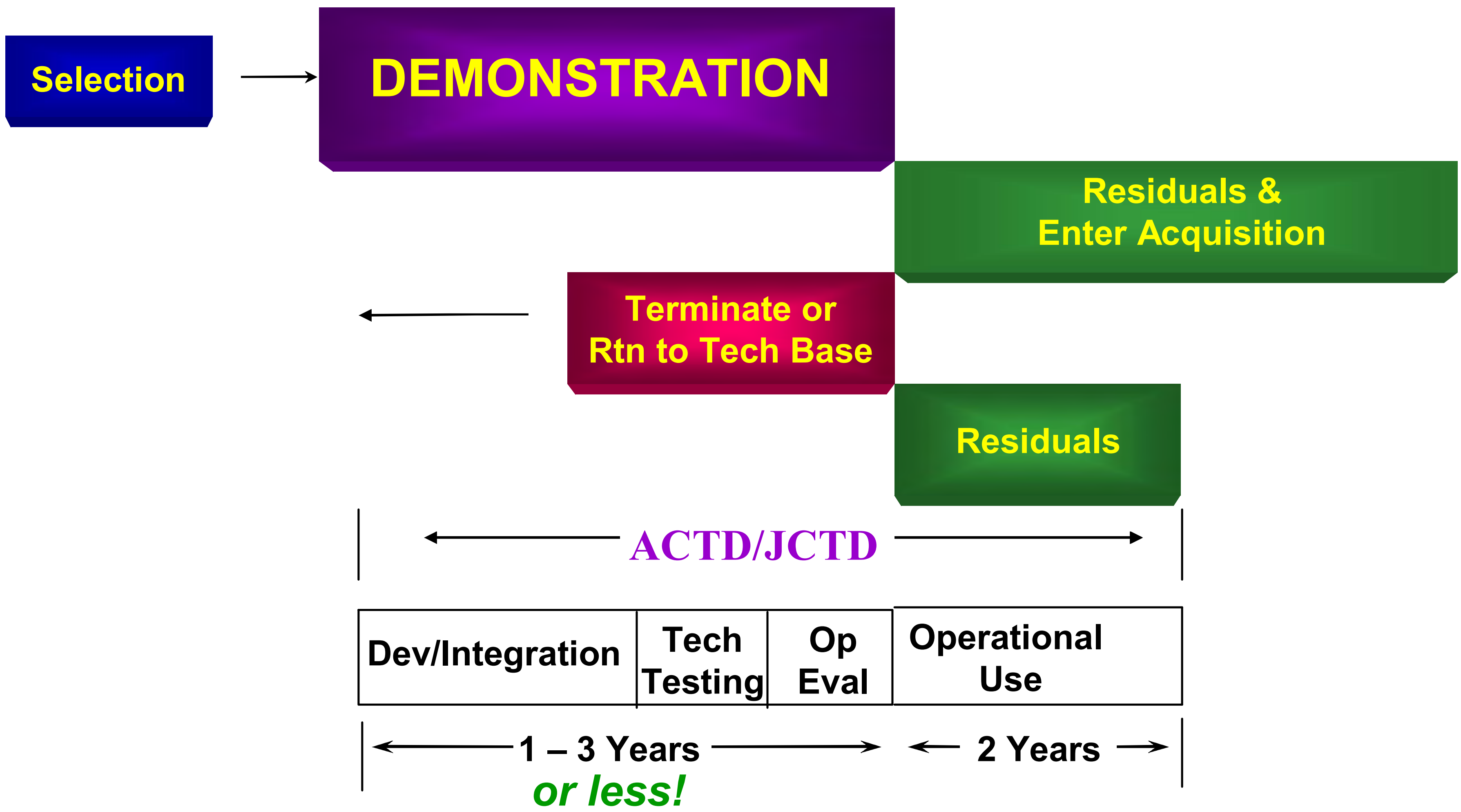
AS&C ACTD/JCTD Program Philosophy:

- Seek effective processes to rapidly respond to CoCom needs for capabilities providing decisive battlefield advantage
- Focus on primary customers: Combatant Commanders
  - Provide sustainable joint warfighter capabilities
  - Emphasize transformational technology & operations
- Rapidly field transformational mature technologies with complementing tactics, techniques and procedures
- Generate, demonstrate and field "80% solutions"
  - Aim for fast delivery of hands-on prototypes
  - Keep moving - maintain rapid spiral tech insertions
- Pursue coalition partnerships
- Engage Services in joint ventures – and TRANSITION!
  - Seek equitable new processes to field & sustain joint capabilities

Get critical joint capabilities based on emergent technology effectively fielded & sustained!

ACTD Timeline

ADVANCED SYSTEMS AND CONCEPTS



Emphasis placed on spiraling out confirmed capabilities as quickly as practicable

Assessing the ACTD Program…

Where Have ACTD's Excelled?

ADVANCED SYSTEMS AND CONCEPTS

- *Showcasing innovative technical & TTP solutions*
- *Nurturing concepts without established communities of interest*
- *Fielding capabilities "just in time" to address emergent threats*
- *Addressing emergent critical technology needs & opportunities*
- *Highlighting limitations of Service-centric PPBES process*
- *Forging Service/Agency partnerships to address joint needs*
- *Embracing CoCom joint and coalition warfare needs*

ACTD/JCTD Transition Models

Transition to Program of Record

- Military utility successfully demonstrated
- Concepts adopted by warfighters
- Products transferred to Program of Record (POR) or GSA schedule
- Acquisition of additional capability funded

Residual Meeting Need of Warfighter

- Military utility successfully demonstrated
- Concepts adopted by warfighter
- Products may or may not have been sent to a POR
- Residual quantities fully meet warfighter needs and are being maintained.

Return to Technology Base

- Military Utility not successfully demonstrated
- Components or capabilities may be incorporated into other systems, transferred to the technology base or terminated.

JCTDs Offer Significant Benefits

ACTDs

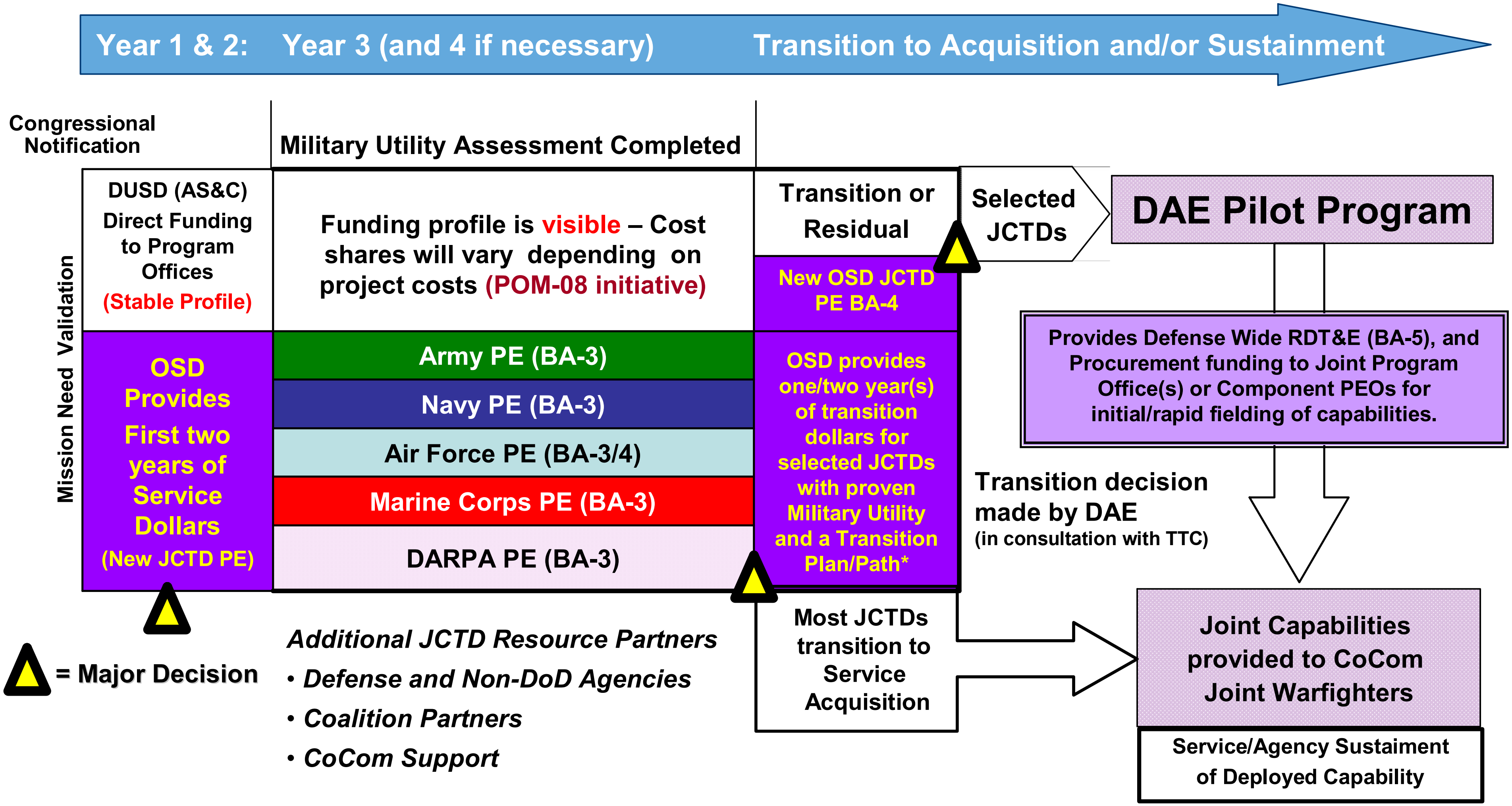
- Innovative & joint efforts
- Partnerships serving CoCom needs beyond core Military capabilities
- Unique perspective on challenges of transitioning proven joint capabilities into acquisition

JCTDs

- Tailors solutions to CoCom needs
- Yields faster starts, faster deliveries
- Structures funding to permit Service participation without "breaking" programs
- Pilots "top-down" DAE process for joint acquisition
- Provides "window on joint investment"

"DoD has a long way to go to ensure that our acquisition process achieves the appropriate jointness and interoperability needed in the 21st Century" **SECDEF Snowflake (2004)**

Joint Capability Technology Demonstration
View of JCTD-DAE-Transition Pilot Program



Joint/Coalition Technology Challenges

Recognizing the Hurdles

- *Defense S&T infrastructure is predominantly Service organizations investing in technologies supporting core Military capabilities*
- *Most joint capabilities include technologies that are developed and acquired by Services as adjuncts to core Service deliverables.*
- *PPBES leaves little room for exploitation of unanticipated discoveries.*
- *Truly innovative joint ventures tend to become program orphans because they represent "unshared bills" to individual Services*
- *Joint aspects of technology investments by Services are frequently the last adds to Service budgets – and the first to go when dollars are tight*
- *CoCom perceived joint requirements are usually near-term, requiring emergent/mature technologies and tailored employment concepts.*
- *Coalition efforts involve "time & complexity tax" that can delay introduction, equating to diminished technology advantage at fielding.*

How Are Joint/Coalition Solutions Acquired & Sustained? Success & Risks

Distributed Procurement …multiple Services and/or agencies agree to acquire system elements with intention of combining in the field to yield a coherent joint operational capability.

Risk…Service-centric solutions migrate away from seamless interoperability.

Trusted Service …Single Services tasked or volunteered to act as DoD agent for acquisition of joint systems to be used by other Services.

Risk…Joint aspects first sacrificed to emergent budget constraints

Joint Program Office …JPMO formed to develop, field joint capability

Risk…Joint Offices proliferate.

CoCom Direct Procurement …CoCom refines requirement, then fields and, in some cases, sustains joint capability

Risk…Duplicated efforts if coordination mechanism not emplaced

Regardless of acquisition strategy, joint capabilities must still find Service home for sustainment

Agile Acquisition Processes

For

Joint Capabilities

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Critical Elements:

- **Needs Determination/Resource Allocation Process**
  - What do joint commanders need to execute their mission?
- **Funding Apportionment/Program & Budget Process**
  - Does funding reflect the end warfighter needs for core military capabilities <u>and</u> specific joint capabilities?
- **Acquisition/Solutions Process**
  - Is the DoD acquisition process (writ large: life cycle) generating warfighting <u>resources</u> relevant to joint customer needs

Needs without funding are just wants…

Acquisition without validated needs is wasteful and potentially disruptive

Need to Solution:
Processes & Roles

Program – Budget Process

Need Process

1. Develop & specify needs
2. Review & comment on budget-based programming and acquisition solutions
3. Allocate resources to joint/combatant commanders

Acquisition Solution Process

1. Consult with needs authorities in development of acqusition solutions
2. Acquire material solutions based on validated needs and budget-based programming
3. Deliver resources (acquisition products) for allocation to joint/combatant commanders

Need Roles

CJCS/JCS

CoComs

Joint Staff

Military Staffs

CoCom/Component Cdr Staffs

Solution Roles

USD (AT&L)/DAE

Service Secretaries/SAEs

OSD (AT&L) Staff

Service Secretariat Staffs

Systems/Materiel Commands

Military Agencies

CoCom Options:
Needs Translation Into Solutions

Component Commander Advocacy (With Parent Service/Agency)

- *Needs must align with core Service/Agency military capabilities*
- *Normally, constrained to PPBES solutions/out-year solutions*

Integrated Priority List (IPL) Submission

- *If long-standing, can be opening input to Service/Agency POM process*
- *Basis for Service program review & adjustment after Service POM closes*
- *Some execution year relief; often yield out-year solutions*

Capability Transition Program Participation

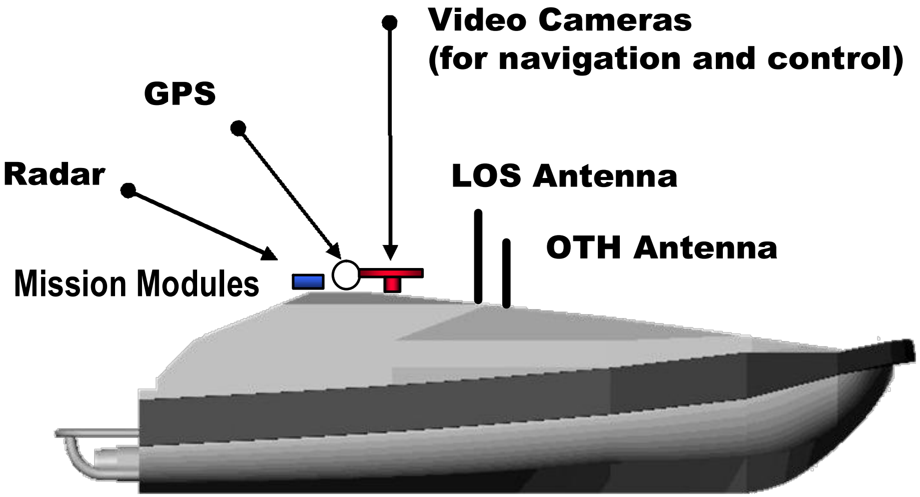
- *Relatively rapid response (0 to 3 years); well adapted for serving joint needs*
- *Limited funding, limited capability residuals*
- *Potential on-ramp for spiral technology improvement or program initiation*
- *Bridges capability gap until PPBES delivers sustained solution*

Joint/Coalition Technology Success

Robotics: SPARTAN

ADVANCED SYSTEMS AND CONCEPTS

To cap the grim day, three al Qaeda-style seaborne bombs driven by suicide killers attempted to destroy Iraq's main revenue lifeline, Basra's offshore oil terminals that have been handling up to 21.6 million barrels a day. **Two US sailors were killed and five injured intercepting one of the three lethal speedboats.** Two more blew up near the oil rig 7 miles out to sea where tankers were moored.



SPARTAN CORE SYSTEM

- Communications link independent
- Common mission module interface
- Off-the-shelf components
- Distributed architecture
- Open source software
- Minimize effort to exchange Mission Modules
- Ensure interoperability in joint and coalition environment

Joint/Coalition Technology Success
Advanced Transportation: TSV

ADVANCED SYSTEMS AND CONCEPTS

Increase Throughput:
- **Soldiers, equipment, leaders go together**
- **Reduce battlespace RSO&I**

Increase Survivability:
- **Threat identification system**
- **Active/Passive rockets/missile defense**

Increase Situational Awareness:
- **Army crewed and armed**
- **Enroute mission planning**
- **Joint interoperable communications**

Increase Responsiveness:
- **Rapid worldwide responsiveness**
- **Access to austere ports**
- **Increase access points within theater**

Improve Closure Rates:
- **36 to 50 knots (~31 to 58 mph)**
- **Sustained deployment momentum**
- **Offset/complement intra-theater airlift**
- **Provide Intermodal Operations Capability**
- **Shallow draft (less than 18 feet)**

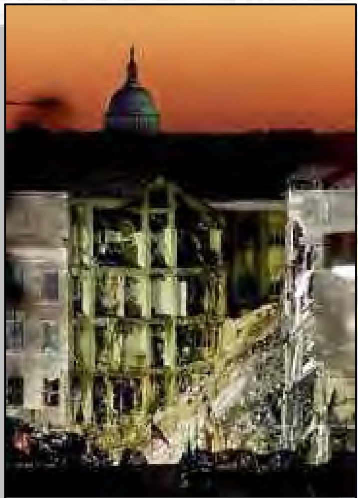
Joint Technology Success

Networking/Human Systems: JEOD KTOD

Advanced Systems and Concepts

Joint/Coalition Technology Success

Data Fusion: Area Cruise Missile Defense



WARFIGHTER PAYOFF

- Limited "single integrated air picture" using JCTN, JDN, and host nation radar sensors
- Enhanced small, low altitude air object detect capability for cruise missile defense
- Improved Full-Dimensional Protection
- Enhanced Air Superiority

MATURE TECHNOLOGY

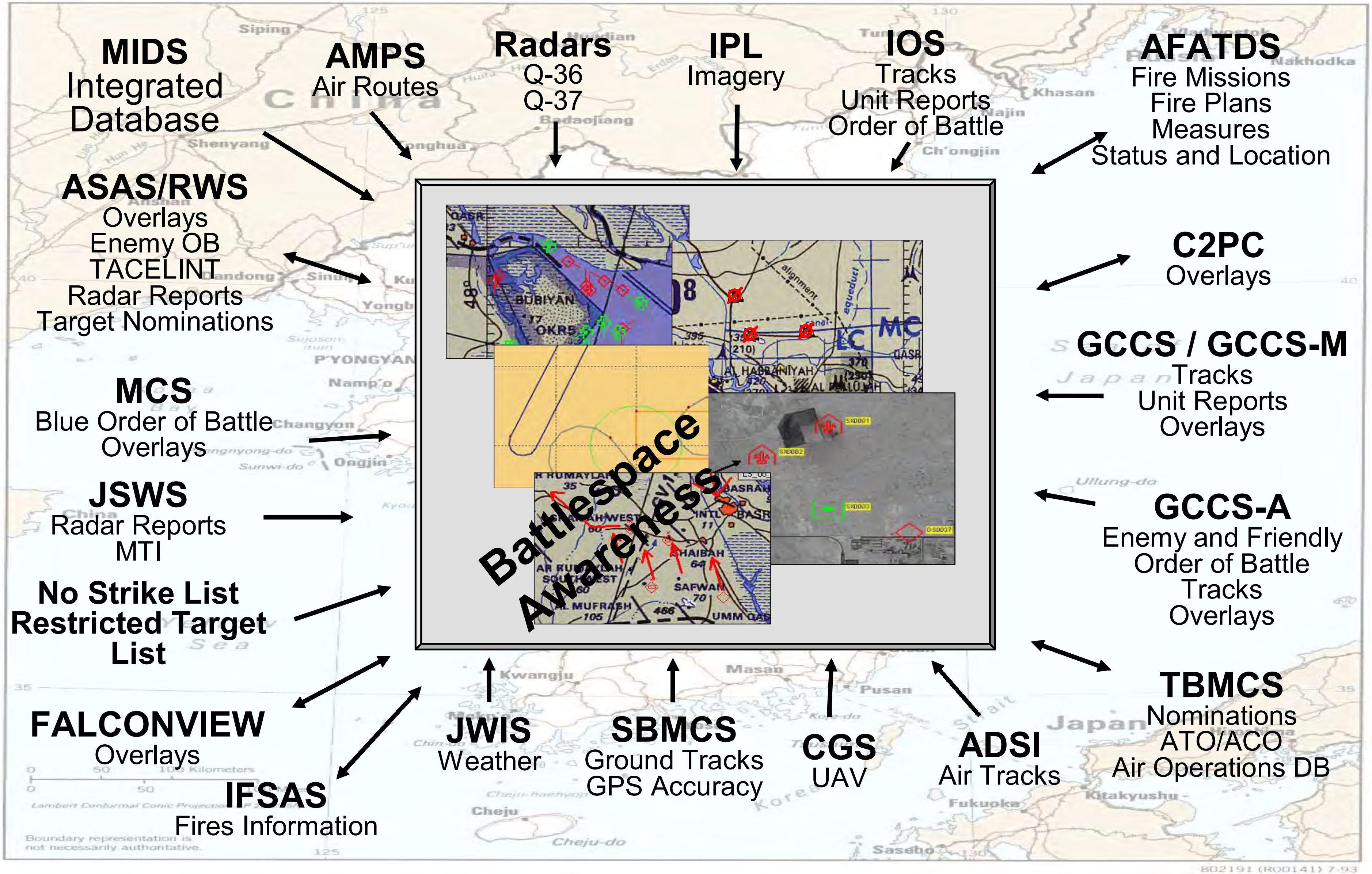
- Proven radar sensors and C2 mediums.
- Maturing fusion/correlation engines.

INTERIM (RESIDUAL) CAPABILITY

- Mobile, tactical interface with fusion/correlation engine and data link for increased interoperability.
- Test range for continued CMD testing and TTP development.

Joint/Coalition Technology Success

Data Integration: ADOCS



Joint Technology Success
Non-Lethal Weapons: Active Denial System

Advanced Systems and Concepts

The Active Denial System ACTD will produce the first non-lethal counter-personnel directed energy weapon for the battlefield.

It uses breakthrough technologies that will provide an unprecedented standoff non-lethal capability to complement lethal weapons across the military force spectrum.

The ADS will provide the warfighter a dramatically new and different non-lethal capability with unparalleled range, speed, and universal effects.

ADVANCED SYSTEMS AND CONCEPTS

Agile Acquisition Processes

For

Joint Capabilities

UNCLASSIFIED

BLU-122 Warhead Program

Precision Strike Technology Symposium

19 Oct 2005

Maj Mike Lauden
BLU-122 Program Manager

Agenda

- Background
- BLU-122 Program Description
- Schedule
- Test Results
- Issues
- Summary
- Challenges

Background

- 1999—Hard & Deeply Buried Target Defeat Capability (HDBTDC) Analysis of Alternatives (AoA)
- Determined That BLU-113 Would Hold The Majority Of The HDBT Target Set At Risk

Background (cont.)

- AF/XORW Directed Demonstration Tests To Gather Data To Validate The HDBTDC AoA—Later Named “Divine Thunderbolt”

Divine Thunderbolt

- 2001—Series Of GBU-28s (BLU-113) Dropped Into Seismic Hard Rock In-Situ Source Test (SHIST) Granite Test Bed At White Sands Missile Range
- Results Indicated Potential Areas Of Improvement In Lethality, Penetration, Survivability, And Insensitive Munitions (IM) Characteristics

Results

- 2003—AF Directed BLU-113 Pre-Planned Product Improvement (P^3I) Program
- Resulted In BLU-122 Program And Slightly Modified GBU-28 Weapon System (GBU-28C/B)

Agenda

- Background
- BLU-122 Program Description
- Schedule
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BLU-122 Program Description

- Requirement: AF Form 1067 (Capabilities Document)– 6 Mar 03
  - Hold 25% (50% Objective) More Targets At Risk, Based On Structural Or Functional Kill, As Compared To Baseline BLU-113
  - Interoperable With B-2A / F-15E Without Modification
  - Pass One IM Test

BLU-122 Program Description (cont.)

- System Description:
  - 5000lb class penetrator
  - Laser, INS or GPS guidance
  - F-15E (2) and B-2A (8)

BLU-122 Program Description (cont.)

- Program Info: Ending System Development & Demonstration (SDD) Phase; Entering Production Phase
  - ACAT III
  - General Dynamics-OTS (Improved BLU-113 Warhead)
  - Raytheon (PAVEWAY III Integration + Guidance/Tail Kits)
  - Production – 350 units

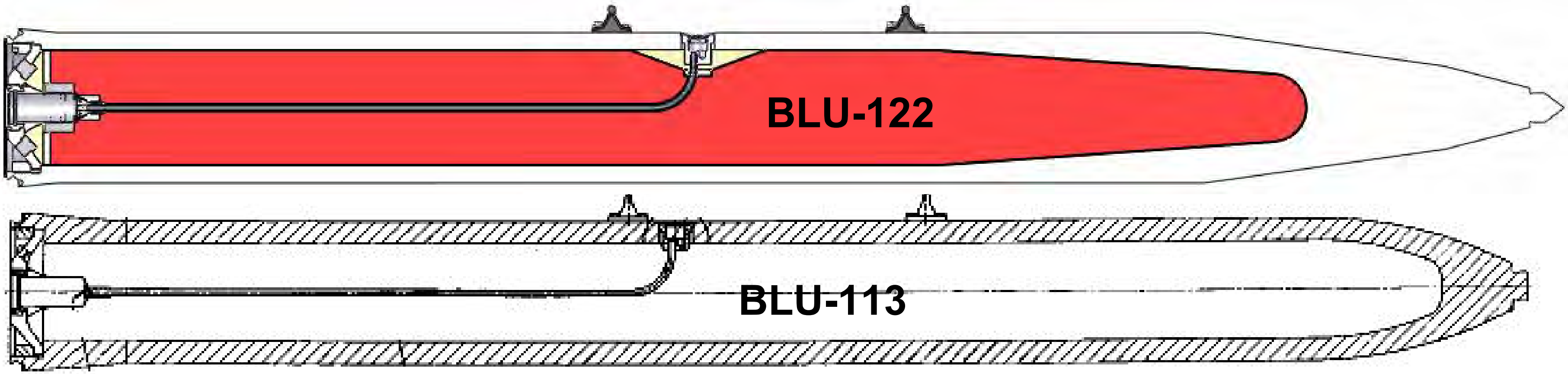
GBU-28C/B System Improvements

- Increased Lethality – More Energetic, Insensitive Fill (781 Lbs)
- Increased Survivability – Higher Strength Case Material, Reduced Loads Transmitted To Fuze
- Increased Penetration – Modified Nose Shape (2.4 Triconic)

GBU-28C/B System Improvements (cont.)

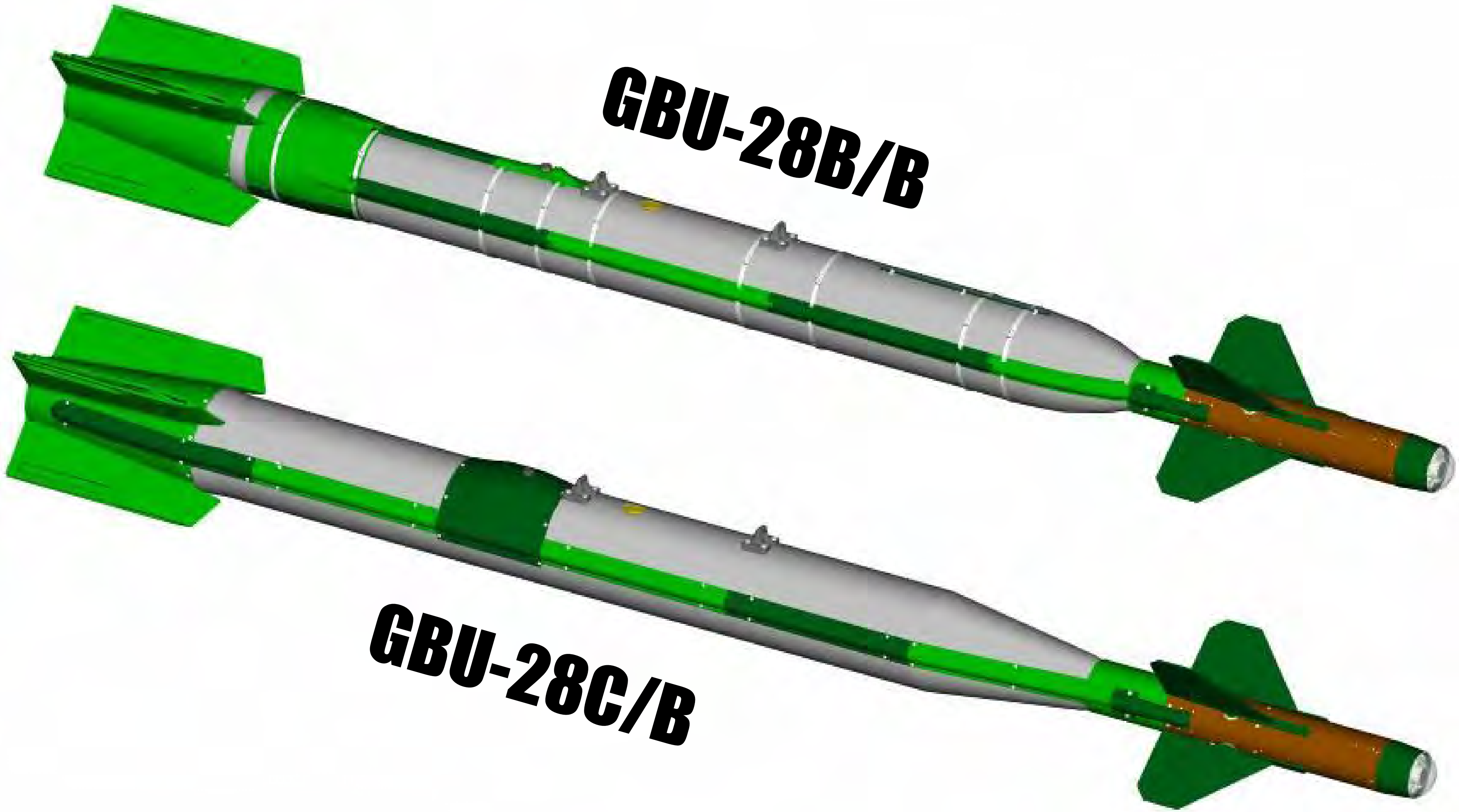
- Incremental Insensitive Munitions Improvements
- Minimal SEEK EAGLE Certification Impact
- Extend Conduit To Accommodate In-Flight Fuze Reprogramming With Joint Programmable Fuze (JPF)

BLU-113 vs BLU-122



	Total Weight	Total Length	O.D.	Case Wall	Explosive Capacity	Explosive	Case Material
BLU-113/B	4500 lbs	153.50”	14.562”	2.281”	625 lbs	Tritonal	HP 9-4-20
BLU-122/B	4450 lbs	159.00”	15.300”	1.750”	781 lbs	AFX-757 w/ PBXN-110 Aux Booster	ES-1

GBU-28B/B vs GBU-28C/B



Agenda

- Background
- BLU-122 Program Description
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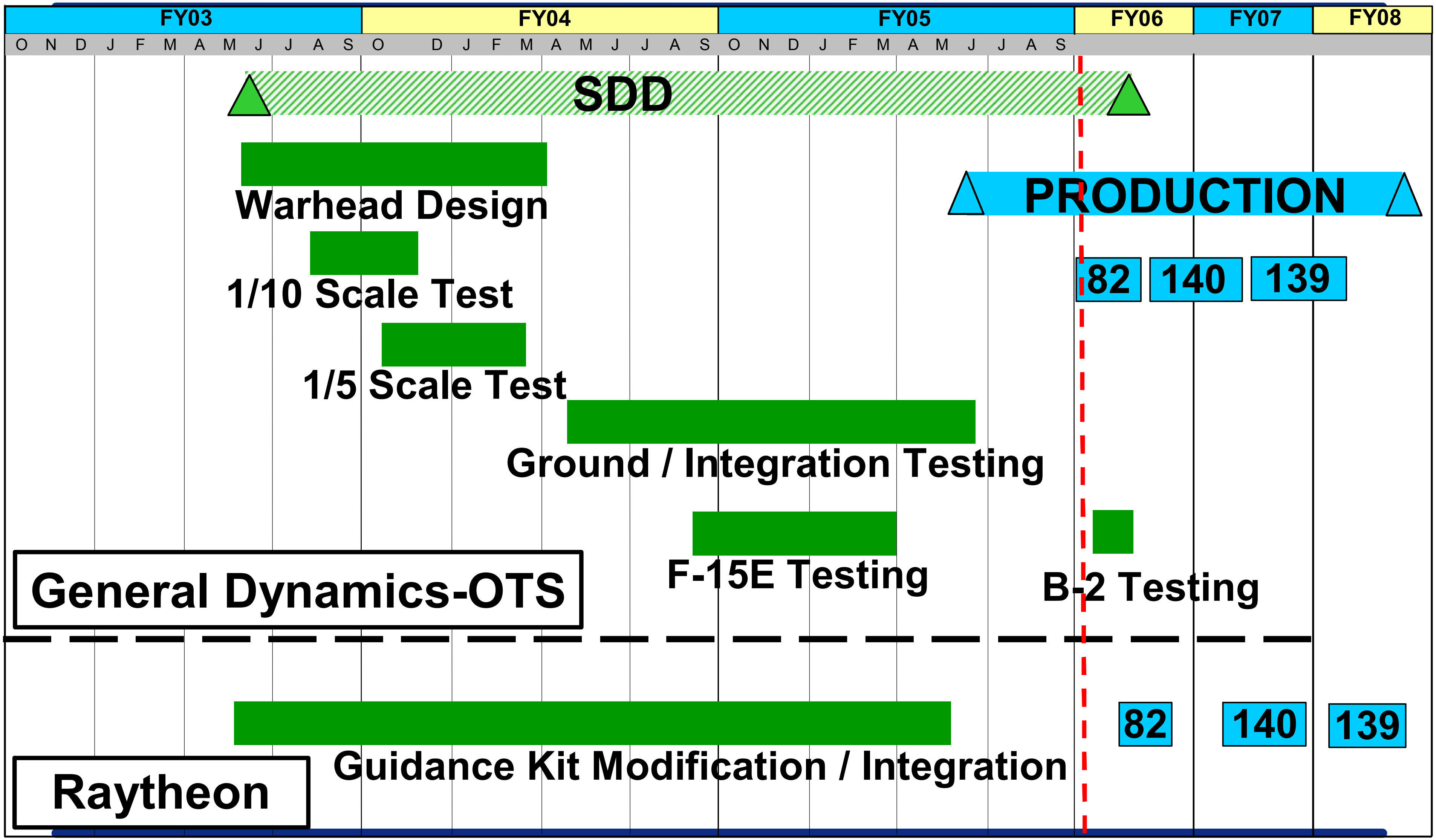
BLU-122 Program Schedule



Current Status

- F-15 Flight Testing Complete
- B-2 Flight Testing in Progress
- Environmental & Safety Testing Complete
- IM Testing In Progress

Current Status (cont.)

- JPF Reprogramming Capability Complete
- BLU-122 Warhead In Production
- GBU-28C/B Guidance/Air Foil Groups In Production
- Low Cost Telemetry Capability Effort Under Way—One Year Effort

Agenda

- Background
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- Challenges

QTAR Scenario Performance

Warhead	Total Targets	Threshold	Objective	Projected Kills
BLU-113 (Baseline)	111	-	-	69
BLU-122	111	87 (25%)	104 (50%)	106 (54%)

- Results From QTAR Model, 17 Mar 04
- Assumes 100% Weapon Reliability

EXCEEDS 50% IMPROVEMENT OBJECTIVE

Case Survivability

- Warhead Case Peak Strain Values Verified Using LaBombA And OTI*HULL Calculations

	BLU-113	BLU-122
Concrete Strength (psi)	Strain (%)	Strain (%)
5000	4.64	3.13
6000	4.71	3.48
7000	4.84	3.67
8000	5.13	3.9
10000	5.26	4.04

30% INCREASE IN CASE SURVIVABILITY

Environmental Testing

- 28-Day Temperature & Humidity Test—Passed
- Vibration Test—Passed
- 4-Day Temperature & Humidity Test—Passed
- 40 Foot Drop—Passed

IM Testing

- Bullet Impact—Passed
- Fragmentation Impact—Passed
- Fast Cook-Off
  - BLU-122 deflagrated in both tests
  - Failed Test, but performed better than BLU-113

REQUIREMENT TO PASS ONE IM TEST

IM Testing (cont.)

- Slow Cook-Off
  - BLU-122 deflagrated in first test
  - Failed test, but performed better than BLU-113
- Sympathetic Detonation
  - Type III reaction in first test
  - Second test scheduled for 19 Oct 05
- Shaped Charge Jet Test—Planned For Spring 2006

Arena Tests

- Three Tests Conducted
  - One Vertical
  - Two Horizontal
- Results Indicated A 70% Increase In Blast Performance Based Upon Measured Peak Pressure

Arena Test Video

Sled Tests

Date	Fuze	Target	Result
2 Jun 04	Accel Package	18 ft/5000 psi Concrete	Explosive Ignition
14 Oct 04	Accel Package	18 ft/5000 psi Concrete	No Reaction *
5 Jan 05	FMU-143 (60 ms)	18 ft/5000 psi Concrete	High Order

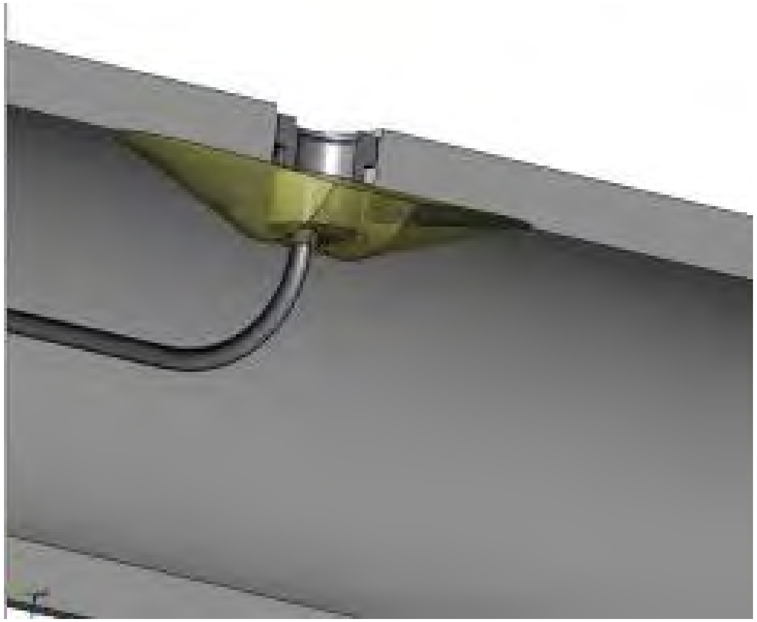
*** INTERNAL PLUMBING REMOVED**

Sled Test
Explosive Ignition

- Warhead Explosive Reaction Observed In Sled Test #1 At 30ms
- Explosive Survivability Verified In Sled Test #2 Without Plumbing Or Fuze Initiator (FZU)
- Fixes:
  - Internal ramp added around FZU well—reduced thermal shock
  - Charging tube material changed from steel to Polyester Ethel Ketone (PEEK)

Sled Test Explosive Ignition (cont.)

- Survivability Of Ramp Design Verified During Flight Test
- Final Configuration Verified In Sled Test #3



Sled Test #1

BLU-122 Sled Test #1

2 Jun 04

Eglin AFB, FL

Sled Test #2

BLU-122 Sled Test #2

14 Oct 04

Eglin AFB, FL

Sled Test #3

BLU-122 Sled Test #3

5 Jan 05

Eglin AFB, FL

F-15E Flight Tests (Dec 04)

Mission	Guidance	Warhead	Fuze	Notes
Flight #1	GBU-28A/B	Inert	Accel Package	Limited Data
	GBU-28A/B	Inert	Accel Package	Good Data
Flight #2	GBU-28A/B	Live Fill	Accel Package	Self Initiation*
	GBU-28A/B	Live Fill	Accel Package	Self Initiation*

* Fuze timed out before ignition

WSMR Drops
Dec 04


PENETRATED 20-22% MORE THAN BLU-113

F-15E Flight Tests (Mar 05)

Mission	Guidance	Warhead	Fuze	Notes
Flight #3	GBU-28A/B	Live Fill	FMU-143 (120 ms)	Fuze Dud
Flight #4	GBU-28A/B	Live Fill	FMU-143 (60 ms)	High-Order
	GBU-28B/B	Live Fill	FMU-143 (60 ms)	High-Order
Flight #5	GBU-28B/B	Live Fill	FMU-152	Fuze Dud
	GBU-28B/B	Live Fill	FMU-152	Fuze Dud

WSMR DT20b

WSMR DT20c

UNCLASSIFIED

DIVINE THUNDERBOLT
20c

03/24/2005

UNCLASSIFIED

WSMR Drops
Mar 05

Apparent Craters (Non-Excavated)

Agenda

- Background
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Fuze Well Test Anomaly

- Fuze Well Separated From BLU-122 Bomb Case
- Occurred During Penetration Of Granite Target
- No Fuze Well Failure During Other Eight Tests In Similar Targets
- Analysis By General Dynamics Found No Design Flaws
- Placed On Watch List

FMU-143 (60ms Delay)

Warhead	***Date***	***Target***	***Result***
BLU-113	**Mar 04**	**UTTR-Granite**	**High Order**
BLU-122	**Jan 05**	**Eglin Sled Test**	**High Order**
BLU-122	**25 Mar 05**	**SHIST**	**High Order**
BLU-122	**25 Mar 05**	**SHIST**	**High Order**

FMU-143 (60ms) IS 4 SUCCESSES / 4 TESTS

FMU-143 (120ms Delay)

Warhead	Date	Target	Result
BLU-113	May 01	SHIST	Fuze Dud
BLU-113	May 01	SHIST	High Order
BLU-113	May 01	SHIST	Low Order*
BLU-113	Sep 01	SHIST	Fuze Dud
BLU-113	Sep 01	SHIST	High Order
BLU-113	Sep 01	SHIST	Fuze Dud
BLU-113	Sep 01	SHIST	High Order
BLU-113	Oct 03	UTTR-Granite	Fuze Dud
BLU-113	Sep 03	UTTR-Granite	Fuze Dud
BLU-122	23 Mar 05	SHIST	Fuze Dud

FMU-143 (120ms) IS 4 SUCCESSES / 10 TESTS

FMU-152 (JPF)

Warhead	Date	Target	Result
BLU-113	Mar 04	Eglin Sled Test	High Order
BLU-113	Apr 04	Eglin Sled Test	High Order
BLU-122	26 Mar 05	SHIST	Fuze Dud*
BLU-122	26 Mar 05	SHIST	Fuze Dud**

* 60ms Delay

** 180ms Delay

Agenda

- Background
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BLU-122 Summary

- 54% More Targets Held At Risk
- 20%+ Improvement In Penetration
- 70% Improvement In Blast Performance
- 30% Improvement In Survivability
- Better IM Characteristics
- Hard Target Fuze Still An Issue

We Need A Hard Target Fuze!!

- FMU-143 G/B (60 ms Delay) Only Fuze Reliable Enough To Employ Operationally
- JPF Not Characterized Against Hard Targets
- BLU-122 Demonstrated Survivability Exceeds That Of JPF
- Portion Of BLU-122 Target Set Does Not Have A Capable Fuze

Questions?

Maj. Mike Lauden
BLU-122 Program Manager

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E-mail: michael.lauden@eglin.af.mil

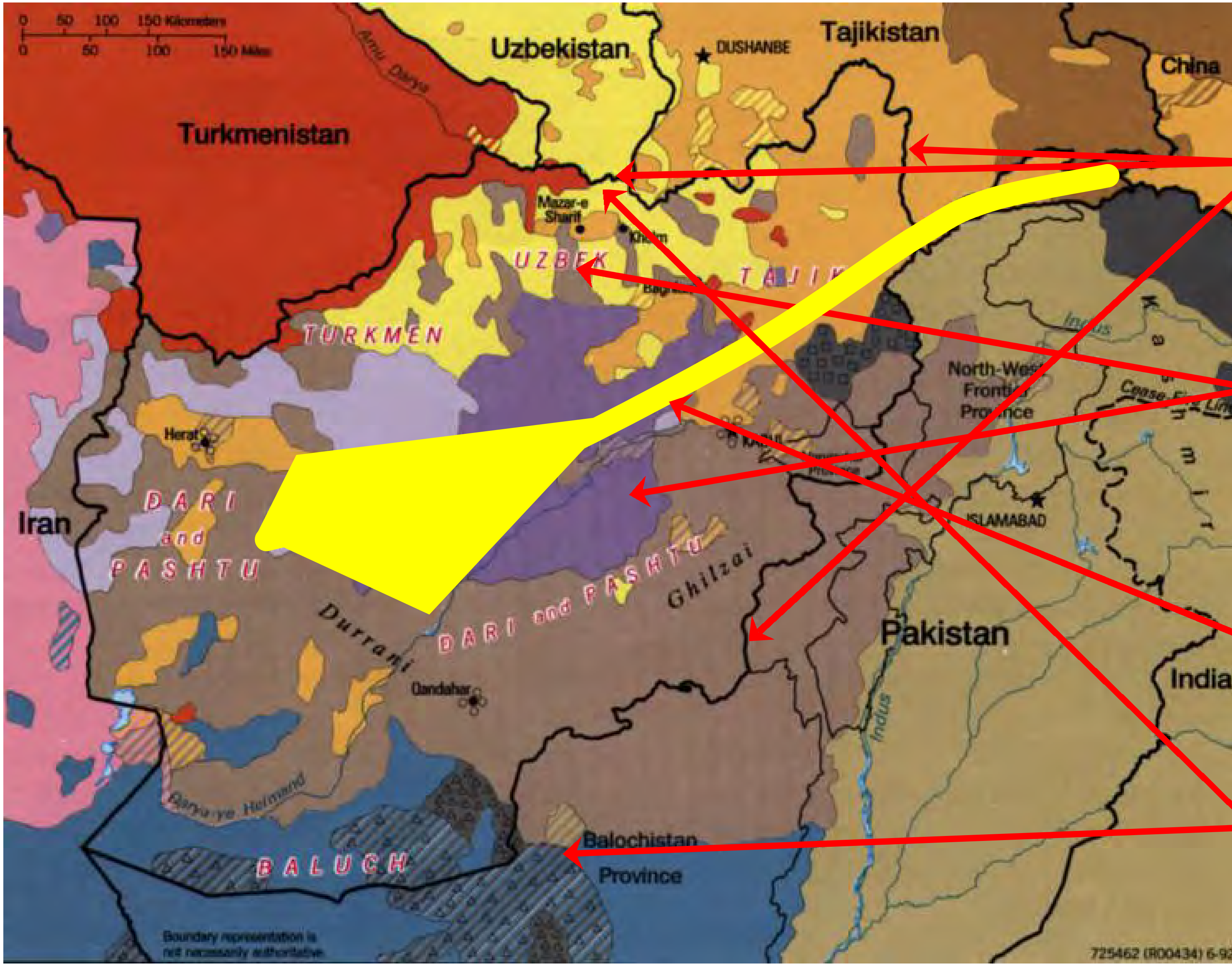
Acronyms

ACAT	Acquisition Category
AoA	Analysis of Alternatives
BLU	Bomb Live Unit
FZU	Fuze Initiator
QTAR	Query Tool for AoA Analysis Results
GBU	Guided Bomb Unit
GPS	Global Positioning System
HDBTDC	Hard and Deeply Buried Target Defeat Capability
IM	Insensitive Munitions
INS	Inertial Navigation System
JPF	Joint Programmable Fuze
P^3I	Pre-Planned Product Improvement
PEEK	Polyester Ethel Ketone
SDD	System Development and Demonstration
SHIST	Seismic Hard Rock In-Situ Source Test
WSMR	White Sands Missile Range

COALITION JOINT TASK FORCE PHOENIX


UZBEKISTAN
KYRGYZSTAN
CHINA
TAJIKISTAN
TURKMENISTAN
Mazar-e Sharif
Qala Jangi
Kunduz
Taloqan
Meymaneh
Bagram
Bamian
Herat
(Hirat)
KABOL(KABUL)
Tora
Bora
Jalalabad
Peshawar
ISLAMABAD
AFGHANISTAN
Shindand
Ghazni
Gardiz
Khost
(Khowst)
Hazar Qadam
Zawar
Kili
Tarin Kowt
Farah
Kandahar
IRAN
Chaman
Quetta
PAKISTAN
INDIA

The Country That Shouldn't Be



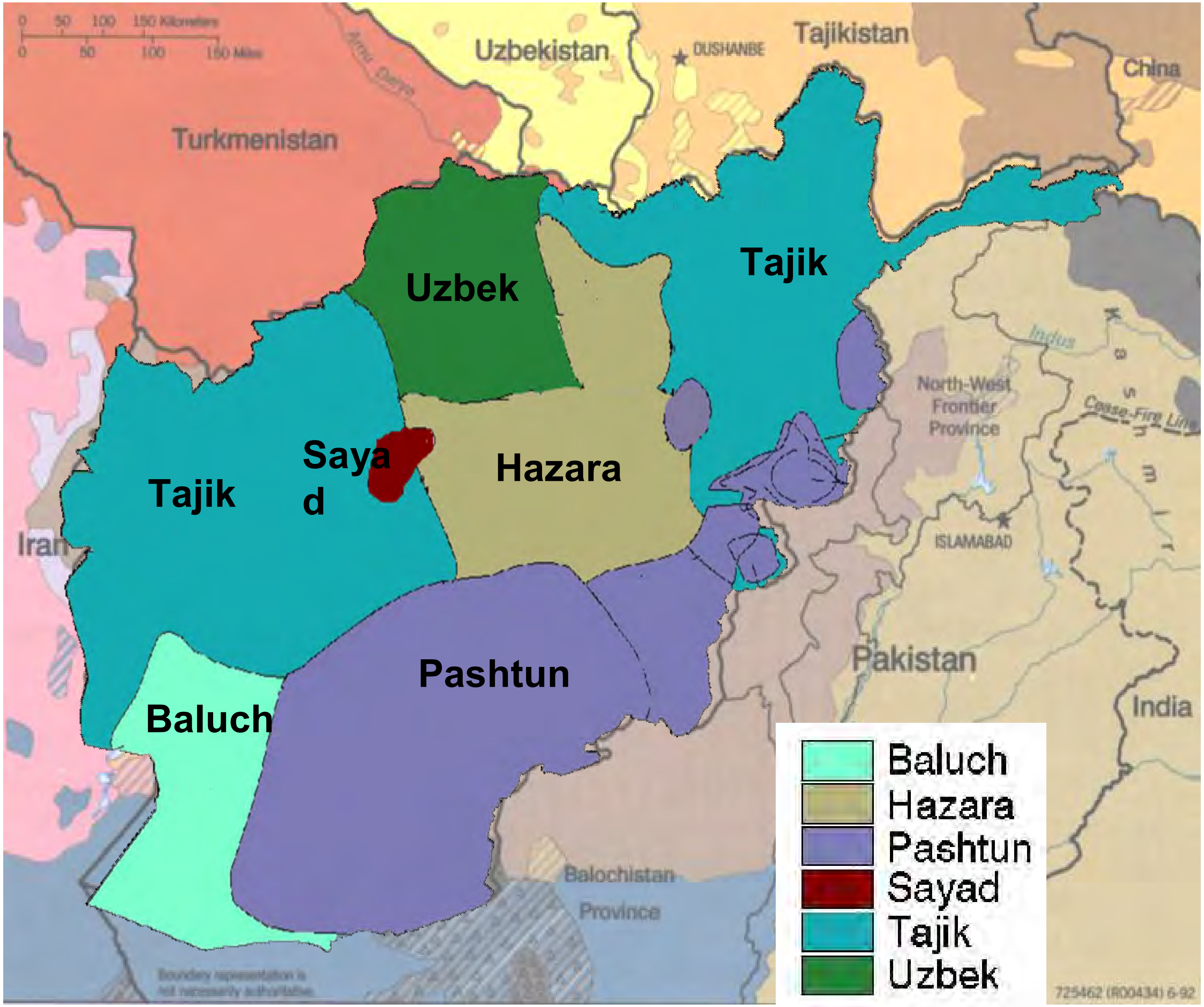
Unnatural Political Borders

Significant Minority Areas

Regionally Isolating Terrain

No Ocean Access

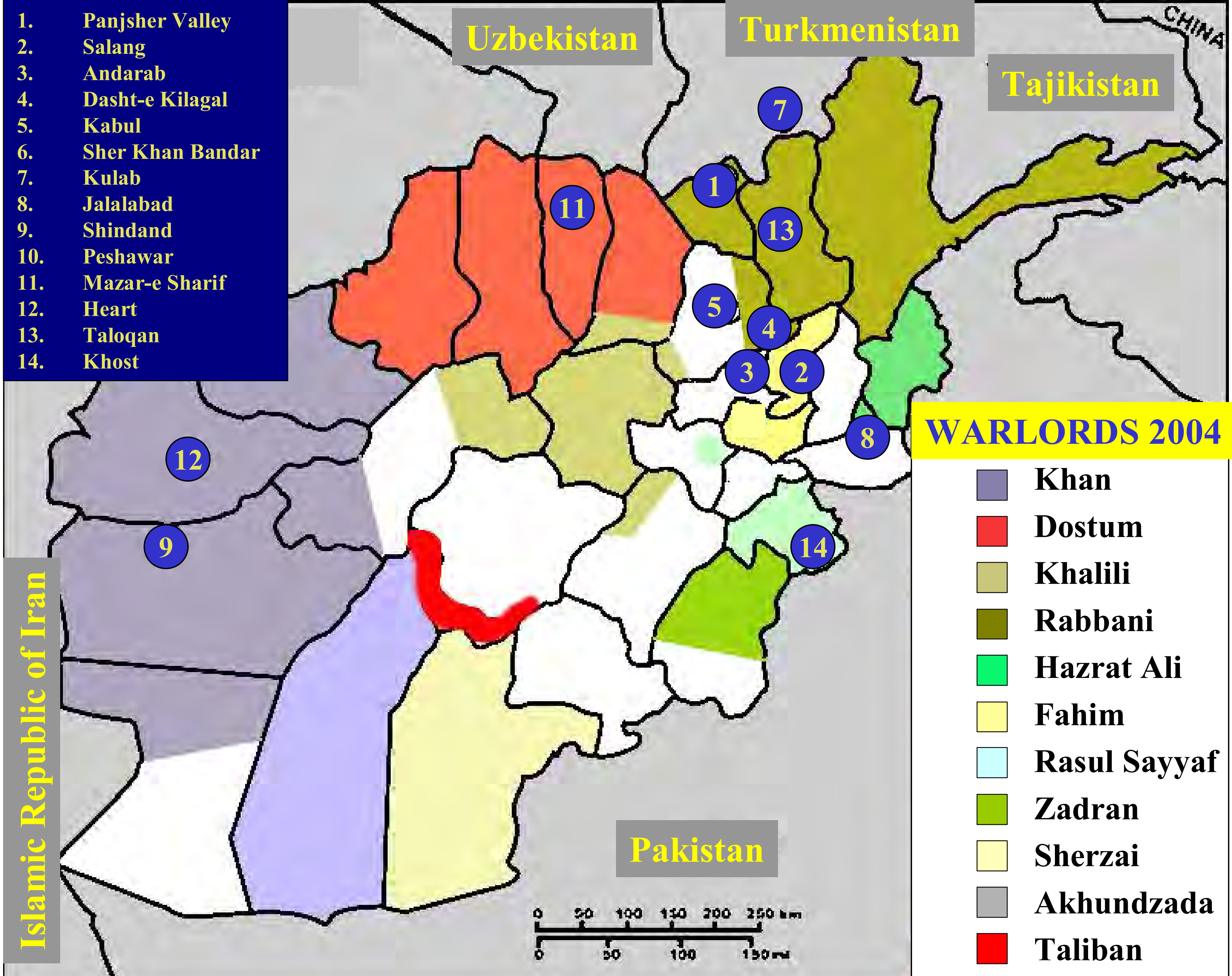
Resulting Power-Base Ethnicity



Afghanistan Major Roads

updated by ReliefWeb: 26.6.96

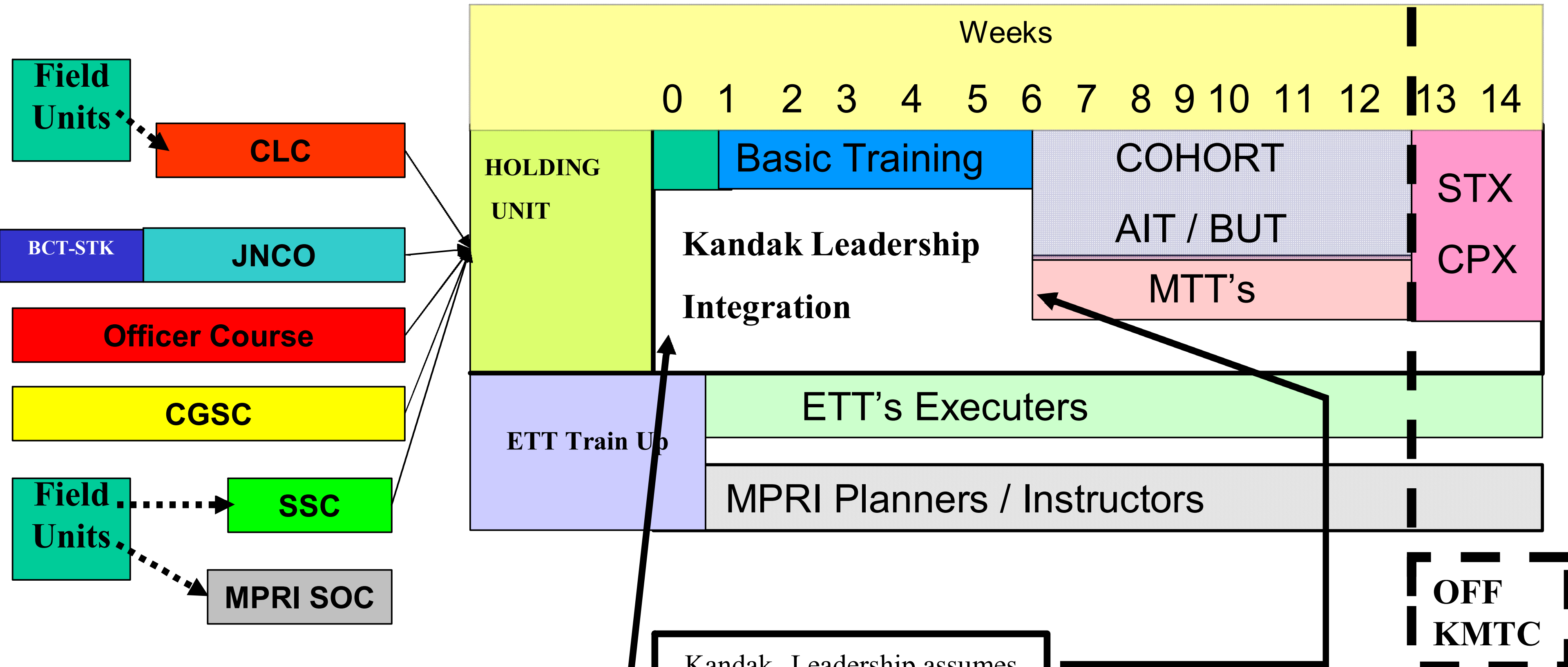
The boundaries and names shown on this map do not imply official endorsement or acceptance by the United Nations or ReliefWeb. These maps may be freely distributed. If more current information is available, please update the maps and return them to ReliefWeb for posting.


1. Panjsher Valley
2. Salang
3. Andarab
4. Dasht-e Kilagal
5. Kabul
6. Sher Khan Bandar
7. Kulab
8. Jalalabad
9. Shindand
10. Peshawar
11. Mazar-e Sharif
12. Heart
13. Taloqan
14. Khost
Uzbekistan
Turkmenistan
Tajikistan
CHINA
Islamic Republic of Iran
Pakistan
WARLORDS 2004
Khan
Dostum
Khalili
Rabbani
Hazrat Ali
Fahim
Rasul Sayyaf
Zadran
Sherzai
Akhundzada
Taliban
0 50 100 150 200 250 km
0 50 100 150 mi

French LNO CD

ANA Training DVD

Performance Oriented Training Model



Performance Oriented Training with focus on troop leading procedures; the orders process, duties and responsibilities, training management, personnel management, supply accountability and management, mission analysis and the military decision making process.

Kandak Leadership assumes responsibility for planning training and operations.

Initial issue of CIF minimum, week 6 leadership receives the balance of equipment for accountability, and issue. This will build bond with the leadership. Issue AK47 at KMTC for solder to take with them. Will not have to re-zero.

International Collaboration
Training The Central Corps

Embedded Trainers

Opportunity Training

ISAF

Germany Canada Romanian Turkey Belgium Greece

OMC-A Staff

Basic Officer Training

Command & Staff Training

France

Basic NCO Training

Combat Leader

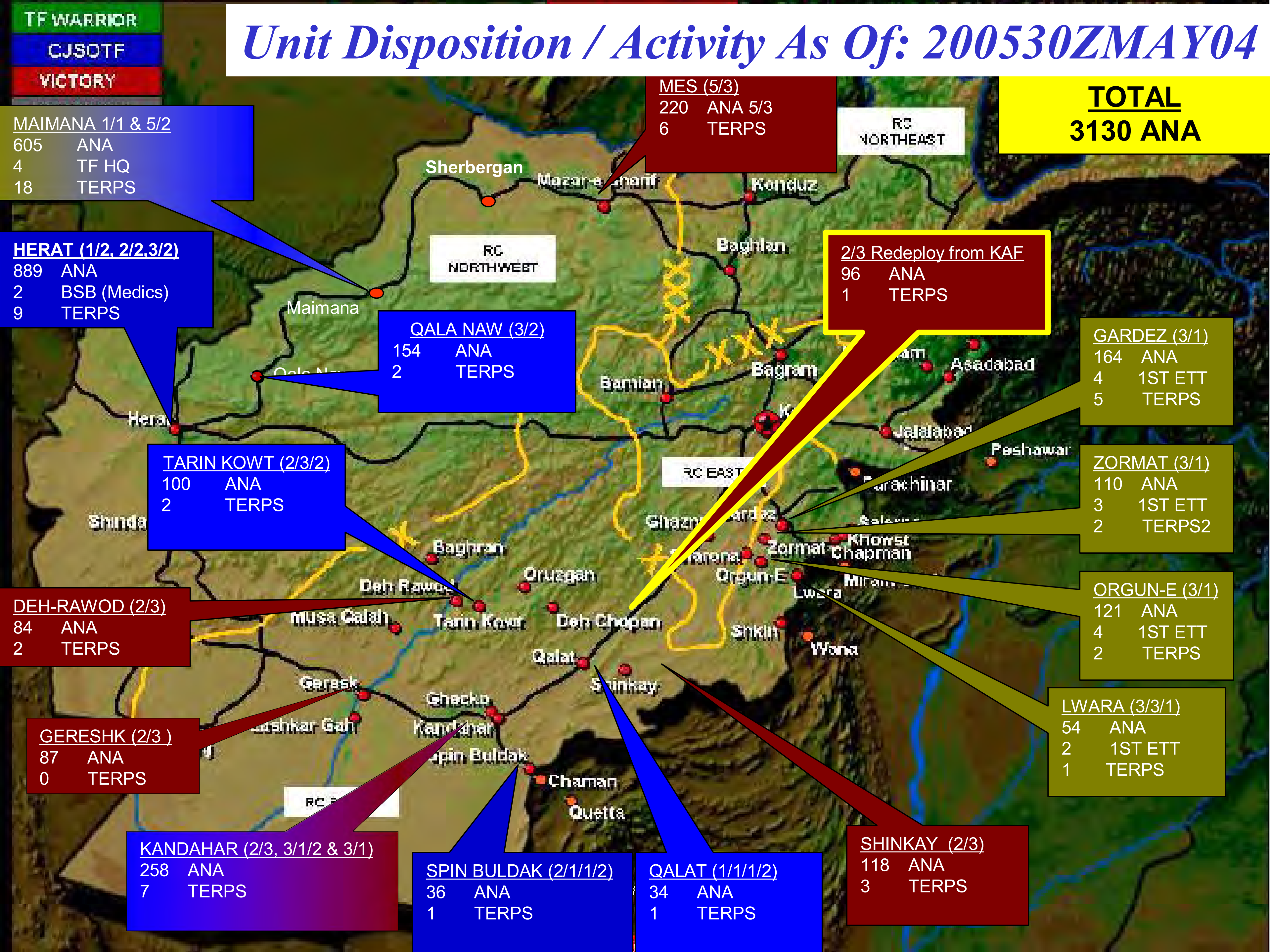
Senior NCO Training

UK

Basic Training

Mobile Training Teams

U.S. Romanian Bulgaria Mongolia

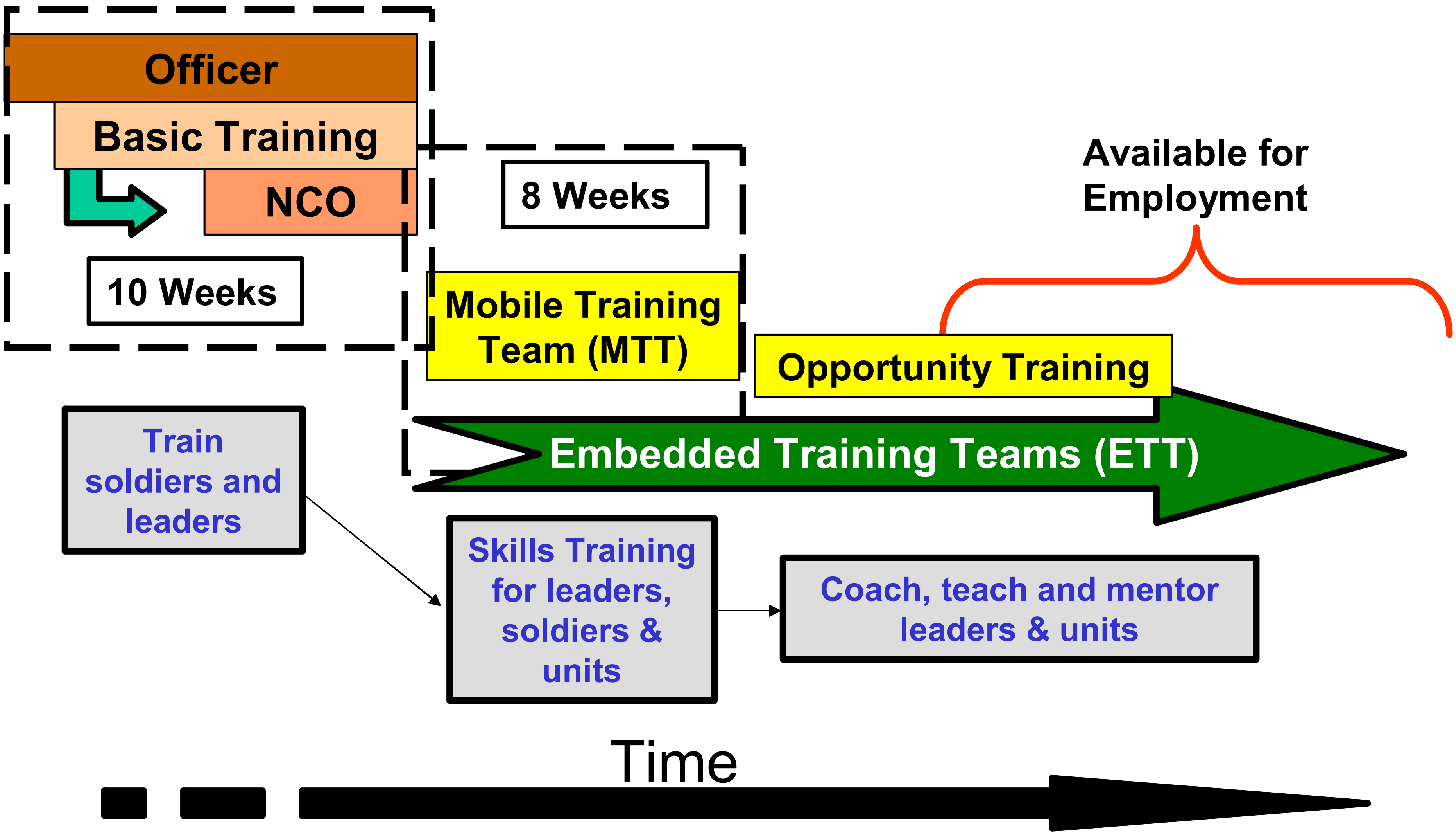


TF WARRIOR
CJSOTF
VICTORY
Unit Disposition / Activity As Of: 200530ZMAY04
TOTAL
3130 ANA
MES (5/3)
220 ANA 5/3
6 TERPS
MAIMANA 1/1 & 5/2
605 ANA
4 TF HQ
18 TERPS
HERAT (1/2, 2/2,3/2)
889 ANA
2 BSB (Medics)
9 TERPS
QALA NAW (3/2)
154 ANA
2 TERPS
2/3 Redeploy from KAF
96 ANA
1 TERPS
GARDEZ (3/1)
164 ANA
4 1ST ETT
5 TERPS
ZORMAT (3/1)
110 ANA
3 1ST ETT
2 TERPS2
ORGUN-E (3/1)
121 ANA
4 1ST ETT
2 TERPS
LWARA (3/3/1)
54 ANA
2 1ST ETT
1 TERPS
TARIN KOWT (2/3/2)
100 ANA
2 TERPS
DEH-RAWOD (2/3)
84 ANA
2 TERPS
GERESHK (2/3)
87 ANA
0 TERPS
KANDAHAR (2/3, 3/1/2 & 3/1)
258 ANA
7 TERPS
SPIN BULDAK (2/1/1/2)
36 ANA
1 TERPS
QALAT (1/1/1/2)
34 ANA
1 TERPS
SHINKAY (2/3)
118 ANA
3 TERPS
RC NORTHEAST
RC NORTHWEST
RC EAST
Sherbergan
Konduz
Baghlan
Maimana
Bamian
Bagram
Asadabad
Herat
Jalalabad
Peshawar
Shindand
Baghran
Ghazni
Zormat
Khowst
Chapman
Orgun-E
Lwara
Oruzgan
Deh Rawod
Musa Qalah
Tarin Kowt
Deh Chopan
Shkin
Wana
Qalat
Shinkay
Geresk
Ghecko
Kandahar
Spin Buldak
Chaman
Quetta

Dey Chopan

RPG Fishing

Kandak Fielding Model



Realizing the Combat Power of Network Centric Operations

CDR John "Snooze" Martins

Lead F/A-18 Hornet & EA-18G Weapon System Integration Team

19 October 2005

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fax- 301-757-7665
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NAVAIR

Key Messages

- Navy has invested in F/A-18E/F and EA-18G aircraft physical architecture, with AESA radar, ATFLIR pod, MIDS/JTRS and DCS radios, ALR-67(v)3, JHMCS, SHARP, GPS-weapons, and the AEA sub-system.
- These aircraft possess the necessary building blocks that will allow Navy to operate, fight, and win on a joint, networked battlefield.

Agenda

- Naval Aviation in Transition....
- F/A-18 Program
  - Sensors
  - Displays
  - Networks
  - Weapons
- Joint Demonstrations and Experiments

CVW Tactical Aviation Evolution

1985	1995	2005	2015	2020

Mission Centric Operations

F-14A
- Outer Air Battle
- Fighter Sweep

A-6 / KA-6
- Strike
- Tanking

A-7
- Light Attack

F/A-18A
- Light Attack

S-3B
- ASUW

EA-6B
- SEAD

E-2C
- Blue Water AEW

Multi-Mission Operations

F-14D

F/A-18A/C
- Precision Strike
- Air Superiority
- RECCE
- FAC(A)

S-3B
- ASUW
- Tanking

EA-6B
- AEA/SEAD

E-2C
- Littoral Ops (Limited)

Technologies :
Multi-role, GPS,
Night Attack……

Network Centric Operations

F/A-18E/F

F/A-18C
- Time Critical Strike
- Precision Strike
  (Fixed and Moving)
- Air Superiority
- CSAR
- RECCE
- FAC(A)
- Battlefield Persistence
- Tanking

EA-6B
- AEA/SEAD

E-2C
- Littoral Ops
- Digital Collaborative Targeting

Technologies :
AESA, Link-16, DCS,
Geo-Registration

Future Operations

F/A-18E/F

EA-18G

F-35B/C

E-2D

- JUCAS

Technologies :
TTNT, JTRS, WPNS
DATA LINKS,
SATCOM, Blue Force
Tracker, Combat ID

The F/A-18 & EA-18G Program

Navy & Marine Corps Inventory

(as of Feb 05)

- 157 A/Bs
- 534 C/Ds
- 212E/Fs (Current)
  - 460 E/Fs Inventory Goal
  - 90 EA-18Gs
- 409 FMS (7 Countries)

The F/A-18 Inventory is the Backbone of Naval Carrier Strike Groups

Critical Programs

- F/A-18A-D
- F/A-18 E/F (ACAT I)
- EA-18G (ACAT I)
- F404/F414
- Software (C++)
- AESA / APG-73 (ACAT I)
- ATFLIR / TFLIR (ACAT II)
- SHARP / ATARS (ACAT III)
- ACS
- FTI II
- ANAV
- PIDS
- SLMP/SLAP/SLEP/CBR+
- FIRST
- ALR-67v(3) (ACAT III)
- AIM-9X, AMRAAM (PMA-259)
- JTRS, AMC&D, ARC-210/DCS (PMA-209)
- JHMCS (PMA-202)
- ICAP III, ALQ-99, LBT (PMA-234)
- IDECM (PMA-272)
- MIDS, MIDS-JTRS (PMW-780)
- AARGM (PMA-242)
- Trainers (PMA-205)
- JDAM, JSOW (PMA-201)
- JMPS (PMA-281)
- LITENING (PMA-257)
- SE (PMA-260)
- MODE 5 IFF (PMA-213)

Facts & Figures (as of 01MAR05)

- PMA-265 Enterprise in FY05: $4.4B
- PMA-265 Enterprise across the FYDP: $25.7B
- Workforce: 1814 across 15 geo locations

  61 MIL 1175 CIV 578 CSS

- Total USN/USMC Squadrons: 60

CNAL	CNAP	USMC	Reserves/RDT&E/NSAWC
11	20	14	15

- EA-18G will replace 12 Squadrons (10 Carrier Air Wing, 1 FRS, and 1 Test)

PB06 ($B)

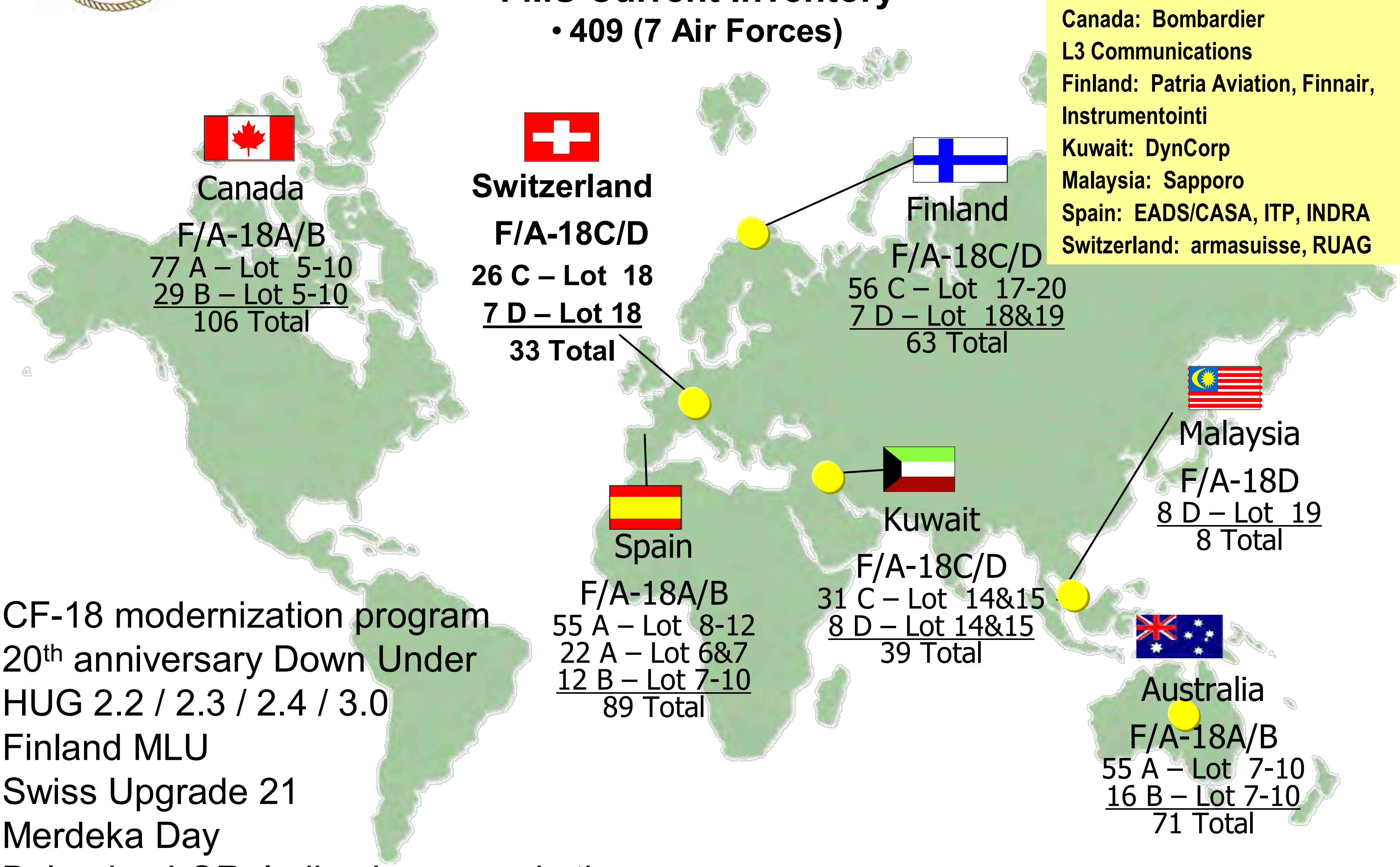
	2004	2005	2006
APN1	3.04	2.98	3.15
APN5	0.37	0.42	0.42
RDT&E	0.37	0.50	0.51
SubTotal	3.78	3.90	4.08
O&M	0.04	0.05	0.05
FMS	0.29	0.49	0.37
TOTAL	4.11	4.44	4.50

FMS Stakeholders

FMS Current Inventory

- 409 (7 Air Forces)

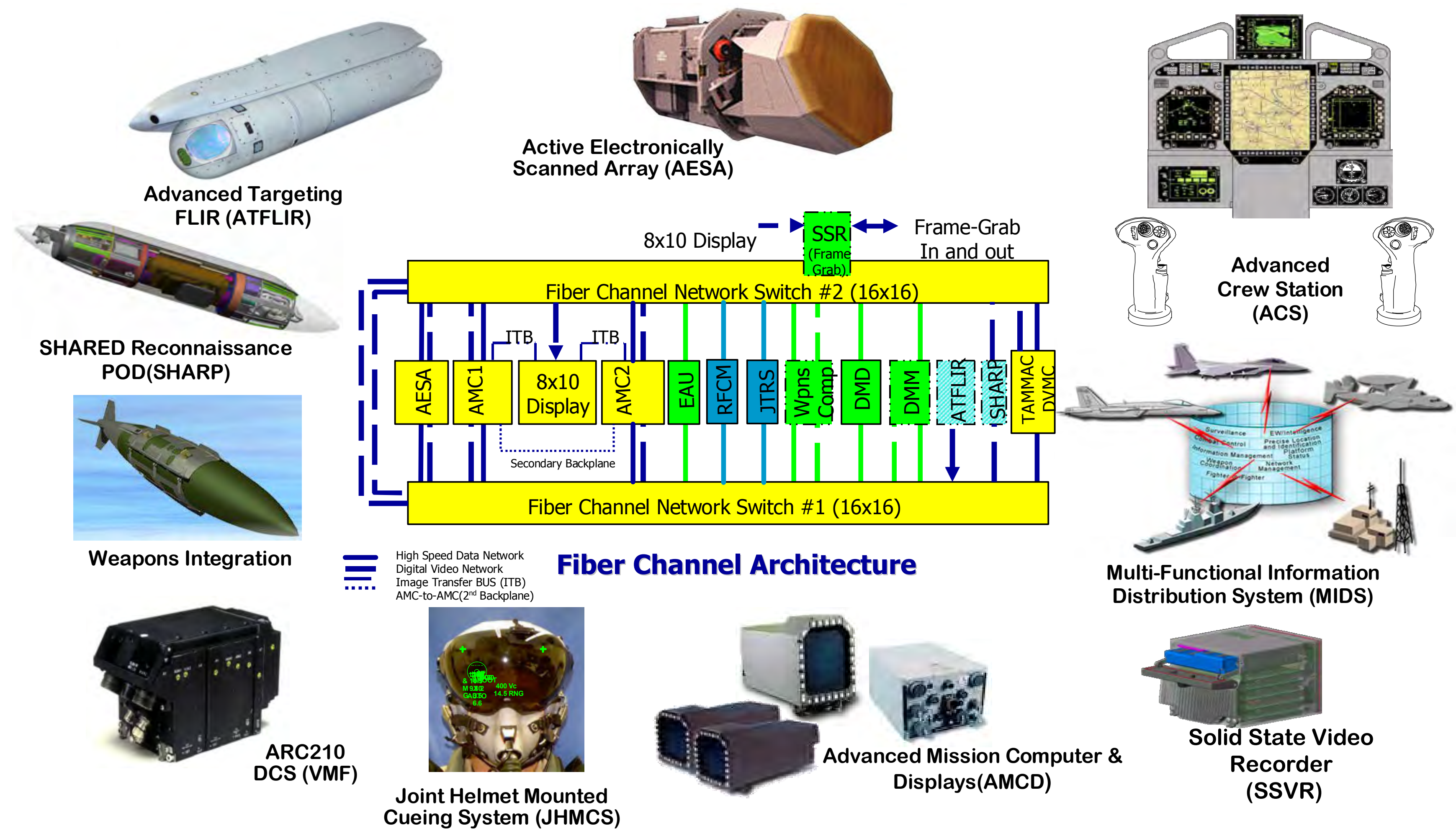
Australia: Boeing Australia, Limited
Canada: Bombardier
L3 Communications
Finland: Patria Aviation, Finnair,
Instrumentointi
Kuwait: DynCorp
Malaysia: Sapporo
Spain: EADS/CASA, ITP, INDRA
Switzerland: armasuisse, RUAG



- CF-18 modernization program
- 20th anniversary Down Under
- HUG 2.2 / 2.3 / 2.4 / 3.0
- Finland MLU
- Swiss Upgrade 21
- Merdeka Day
- Bulgarian LOR, India, Japan, and others

NAVAIR

F/A-18 Integrated Architecture Roadmap



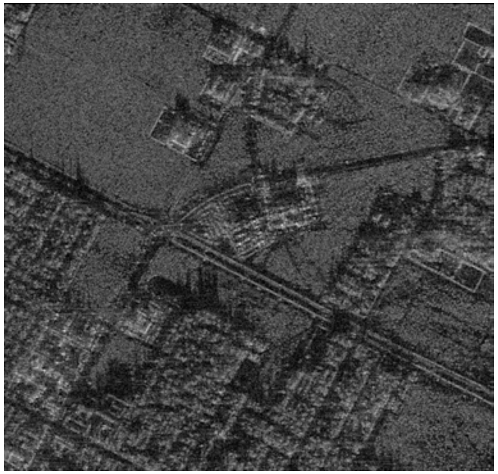
- Scalable, Portable, Flexible and Open Architecture
- Modular HOL(C++) Software Organization SEI CMM Level 5

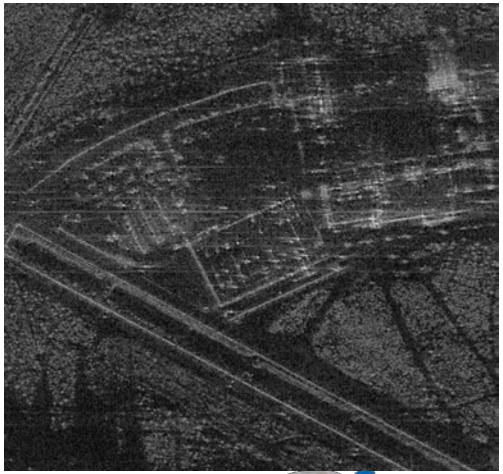
AESA Radars in Production

Facts and Figures

- First Fleet delivery in November 2005
- Four AESA Super Hornets in flight test
- Raytheon delivered three AESA radars to Boeing production line ahead of time
- Twenty already on contract

Ready for VX-9 Operational Assessment



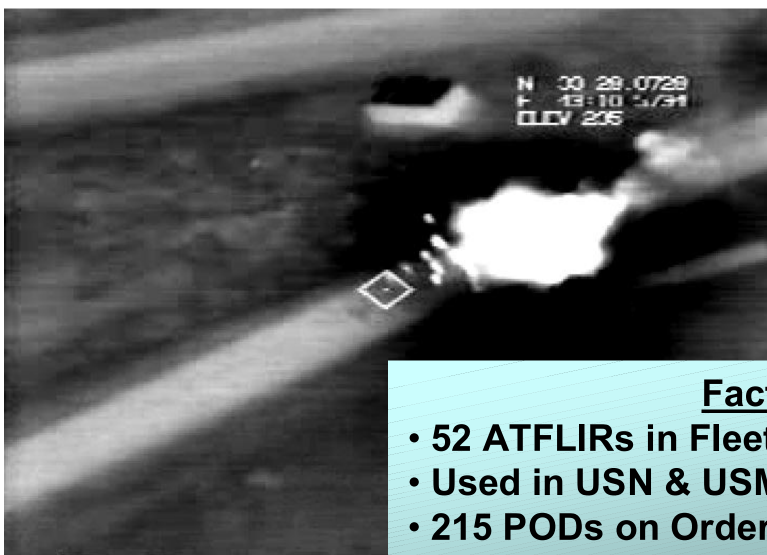


ATFLIR

Tactical Impact / OIF

- **URBAN CAS**
  - **70% Night Operations**
- **ISR / Pipeline Surveillance "Road Recce"**
  - **High Value Targets**
  - **Personnel (Individual on Building)**
  - **Vehicles**

Non-Traditional ISR Missions

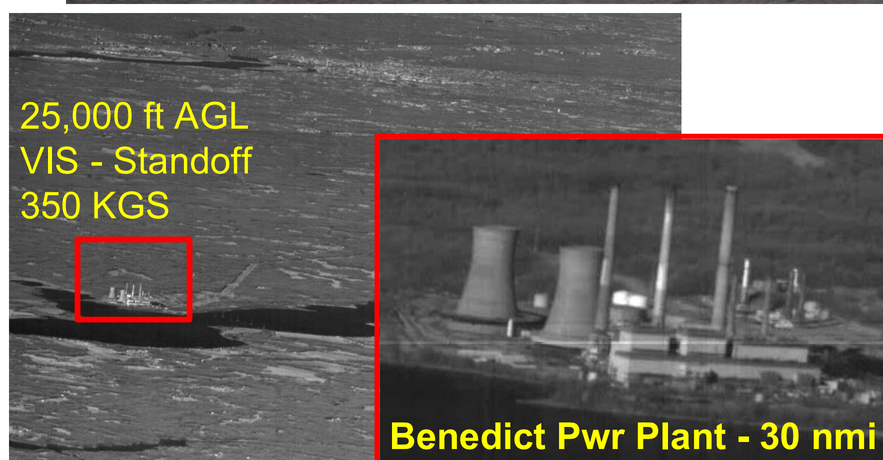


Facts and Figures

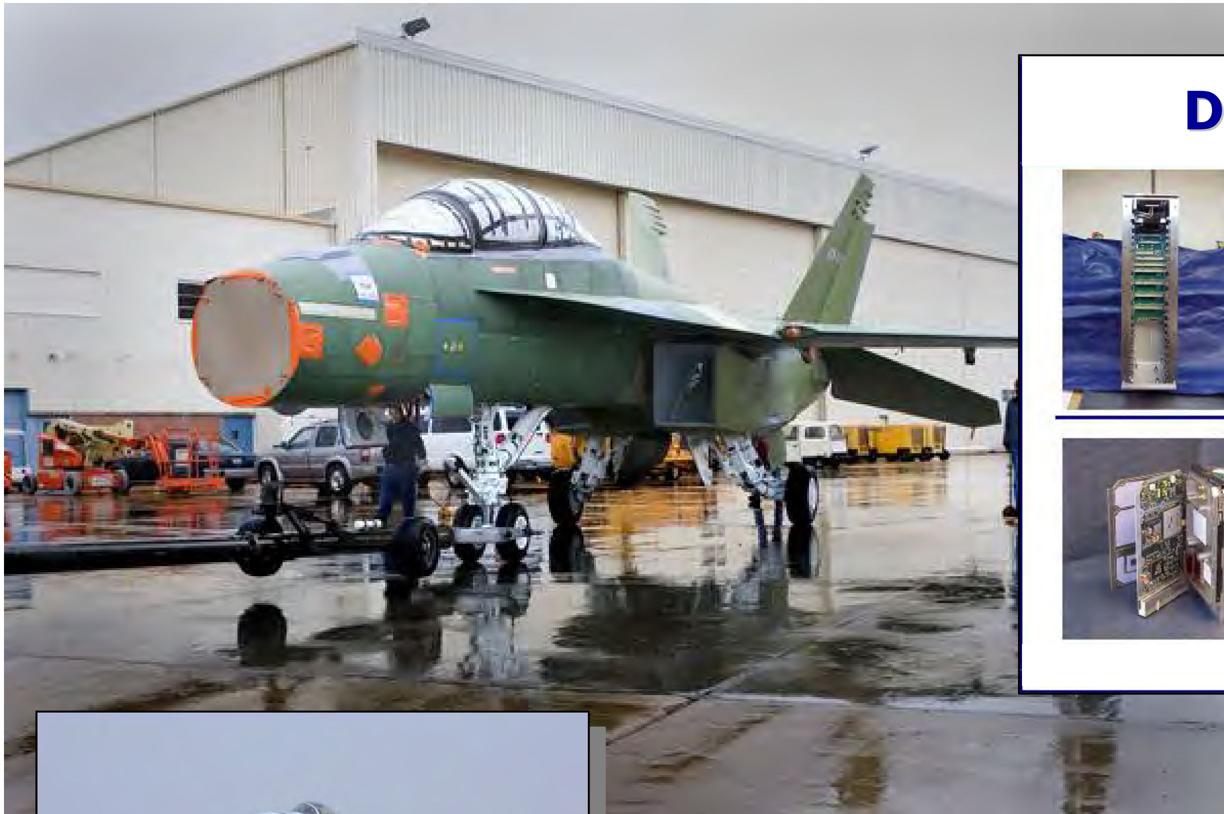
- **52 ATFLIRs in Fleet**
- **Used in USN & USMC aircraft: F/A-18A+/C/D/E/F**
- **215 PODs on Order**

SHARP Enters OPEVAL

Simultaneous collection of EO and IR

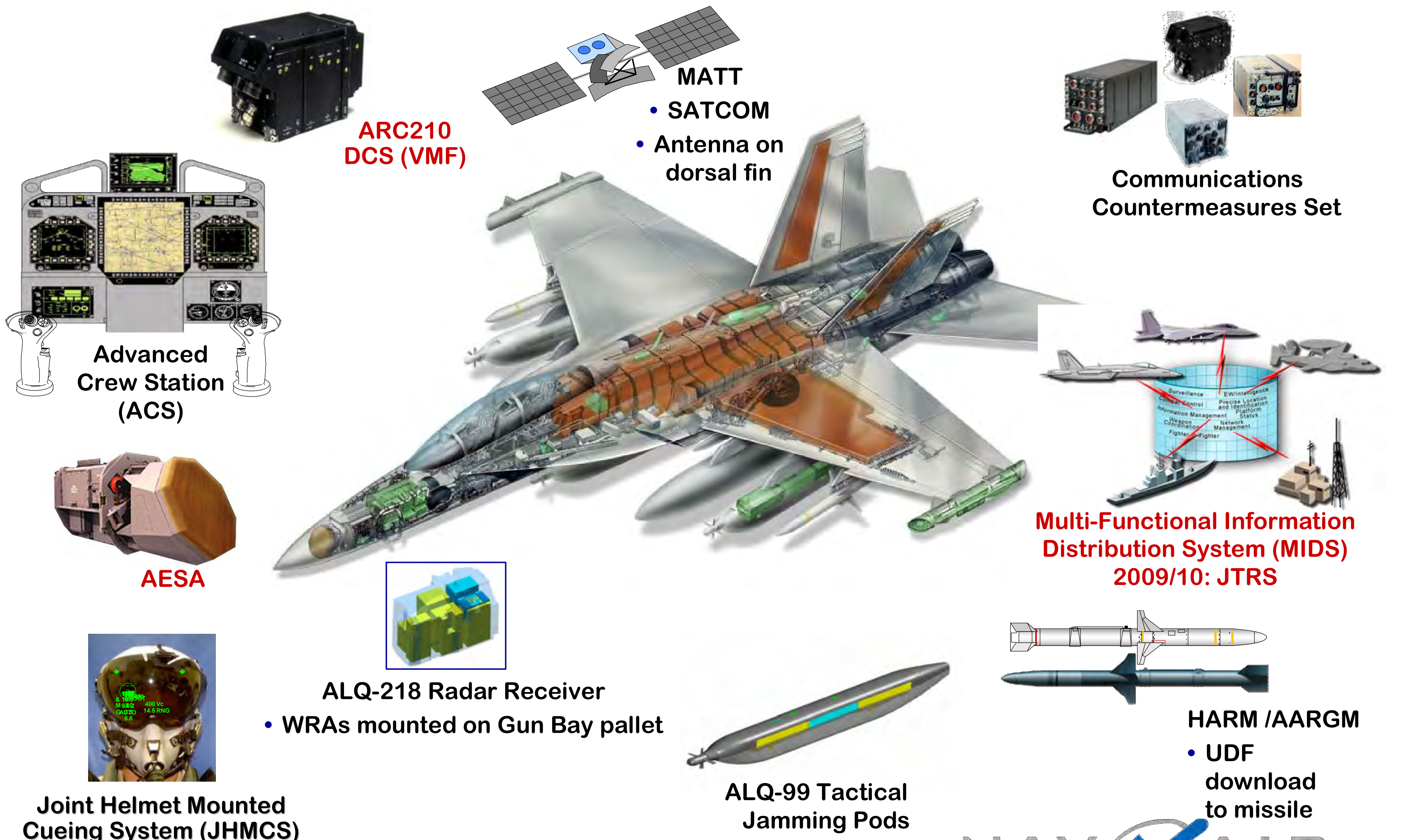


First EA-18G Test Aircraft Moves into Modification Line



- Cost, Schedule, Performance as planned
- GTAT, CONOPS, QFD to shape the future
- On track to IOC in FY-09

EA-18G Products



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JHMCS Aft Seat Test Underway F/A-18D and F/A-18F

8 X 10 Ready For Service
Advanced Crew Station Under Cost

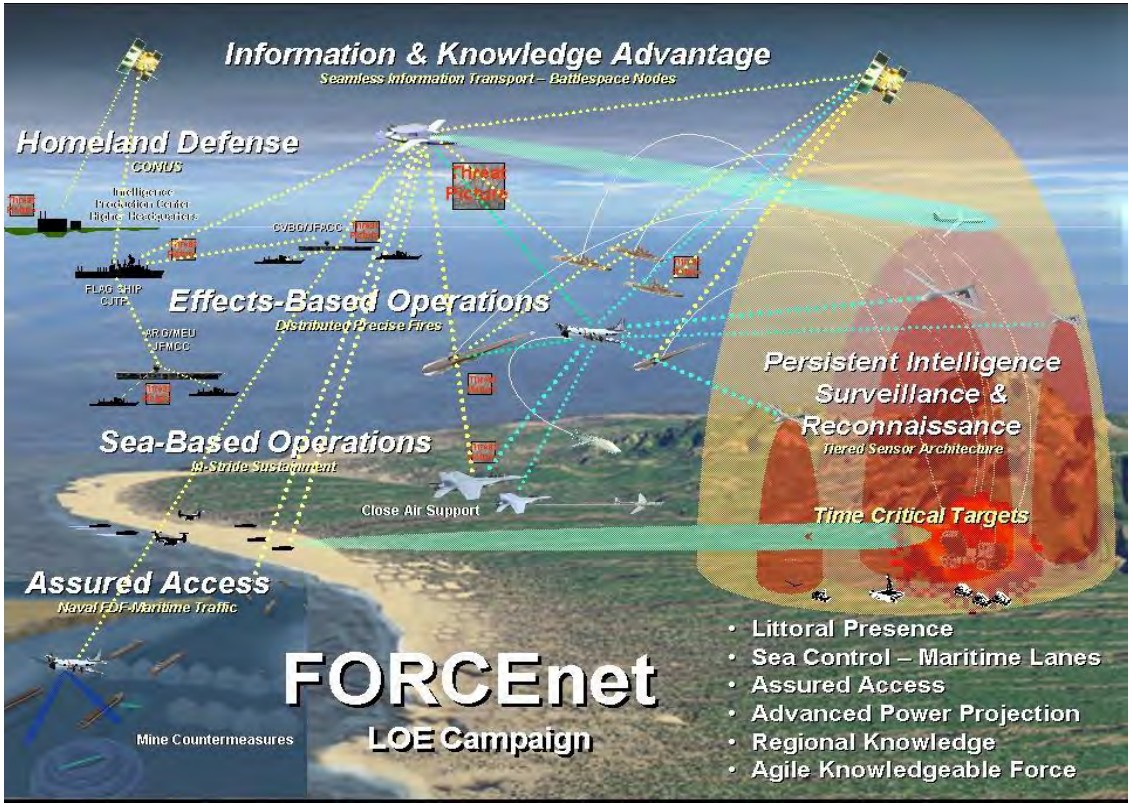
Sea Power 21 (21st Century Naval Capabilities)

- Sea Strike (Power Projection)
- Sea Shield (Theater Ballistic Missile Defense)
- Sea Basing (Deployment and Floating Logistics)

FORCEnet is the architecture of sensors, networks, and weapons to enable these capabilities.

FORCEnet

<u>SSG XXI Definition</u>: "The <u>operational construct and architectural framework</u> for Naval Warfare in the Information Age which integrates Warriors, sensors, networks, command and control, platforms and weapons into a <u>networked, distributed combat force, scalable</u> across the spectrum of conflict from seabed to space and sea to land."

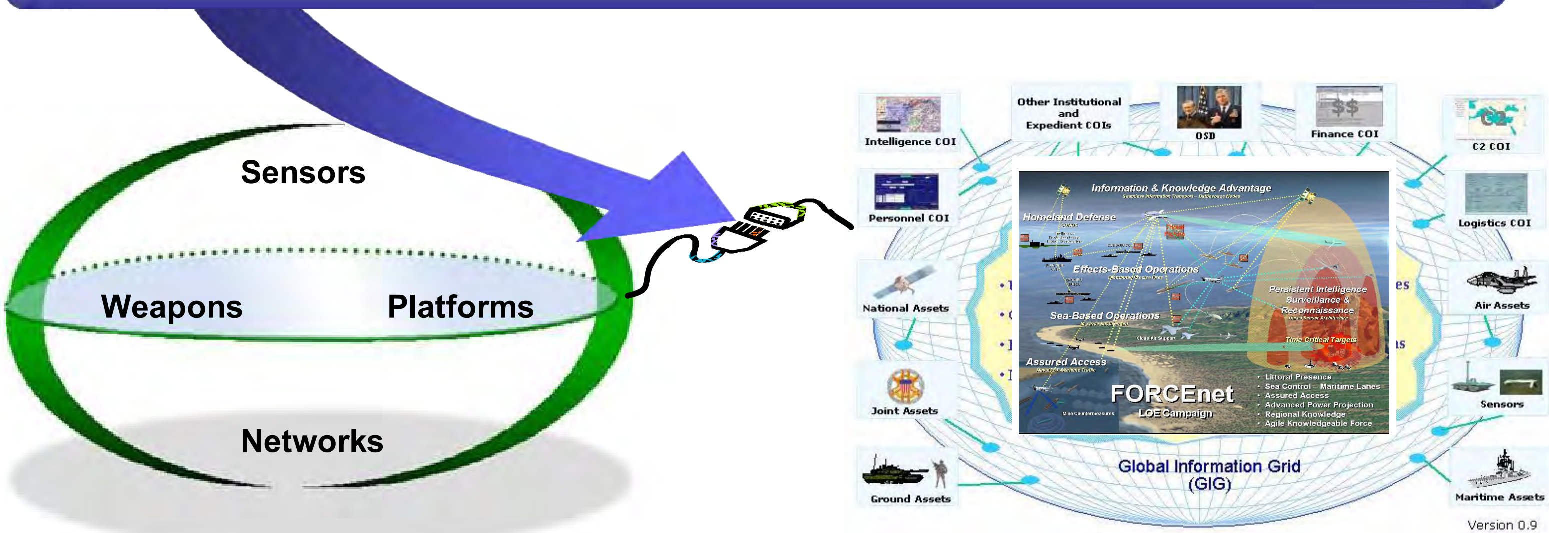


Naval Aviation in Transition….

Mission Capability Focused: Speed, Agility, & Alignment

- **We must be networked and interoperable with joint forces (MTM)**
- **We must possess the ability to move tactical war fighting information seamlessly on/off the aircraft and across a networked force**
- **We must manage at the interface**

• Information Elements	• Network Spec	• COI's and Training
• Std & Arch Implementation	• ICDs	• CONOPS



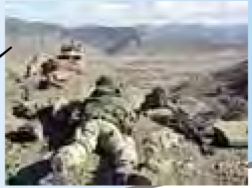
What's the future Machine-to-Machine architecture look like?

NCO Strategy

EA-18G

- Near-term NCO - existing links, translators
- Future NCO - Wideband network (JTRS), SATCOM

Key NCO upgrades



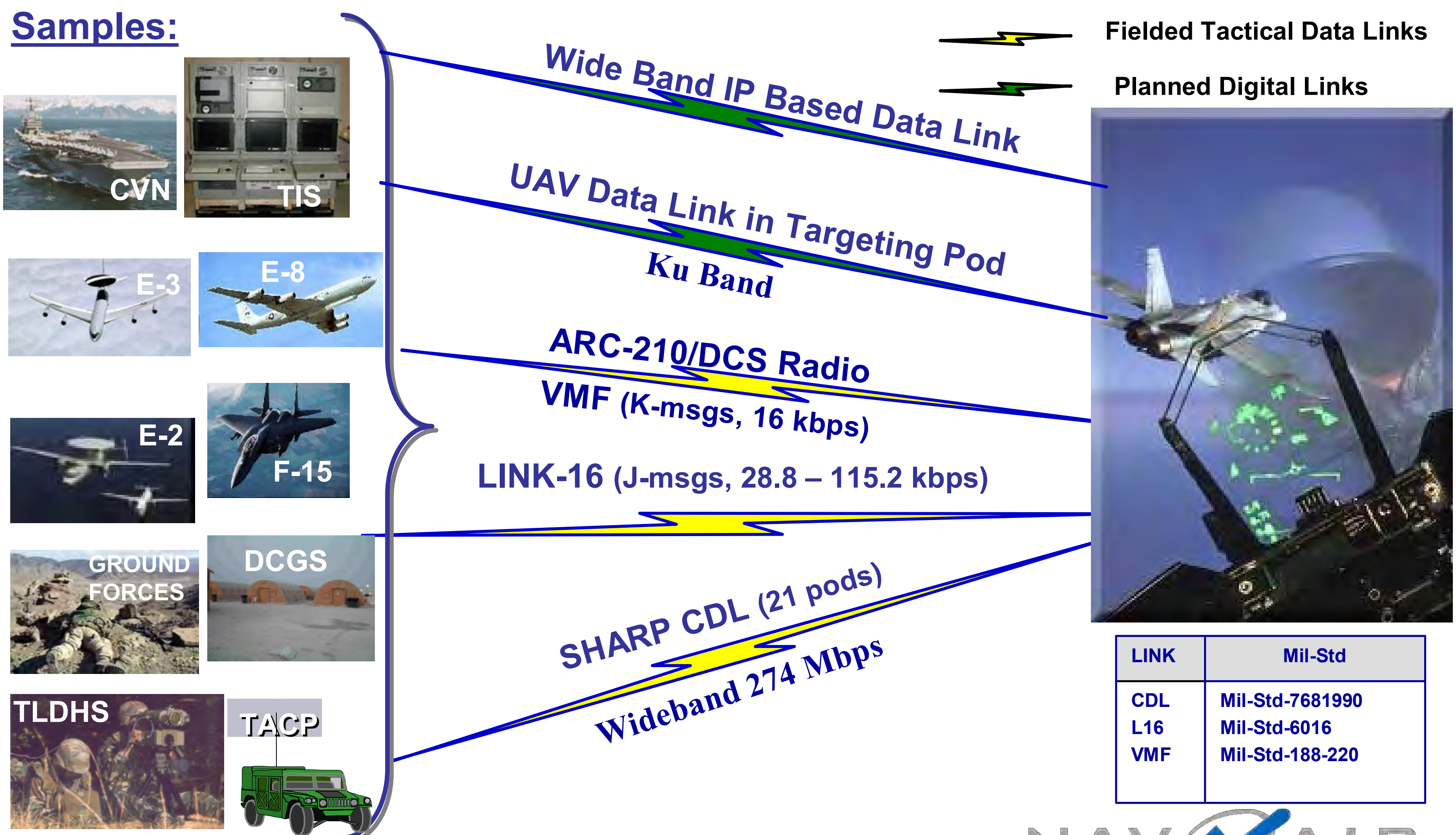
Transformational capability

F/A-18E/F

- Linking ground troops and aircrews
- Tactical imagery, image exploitation/targeting

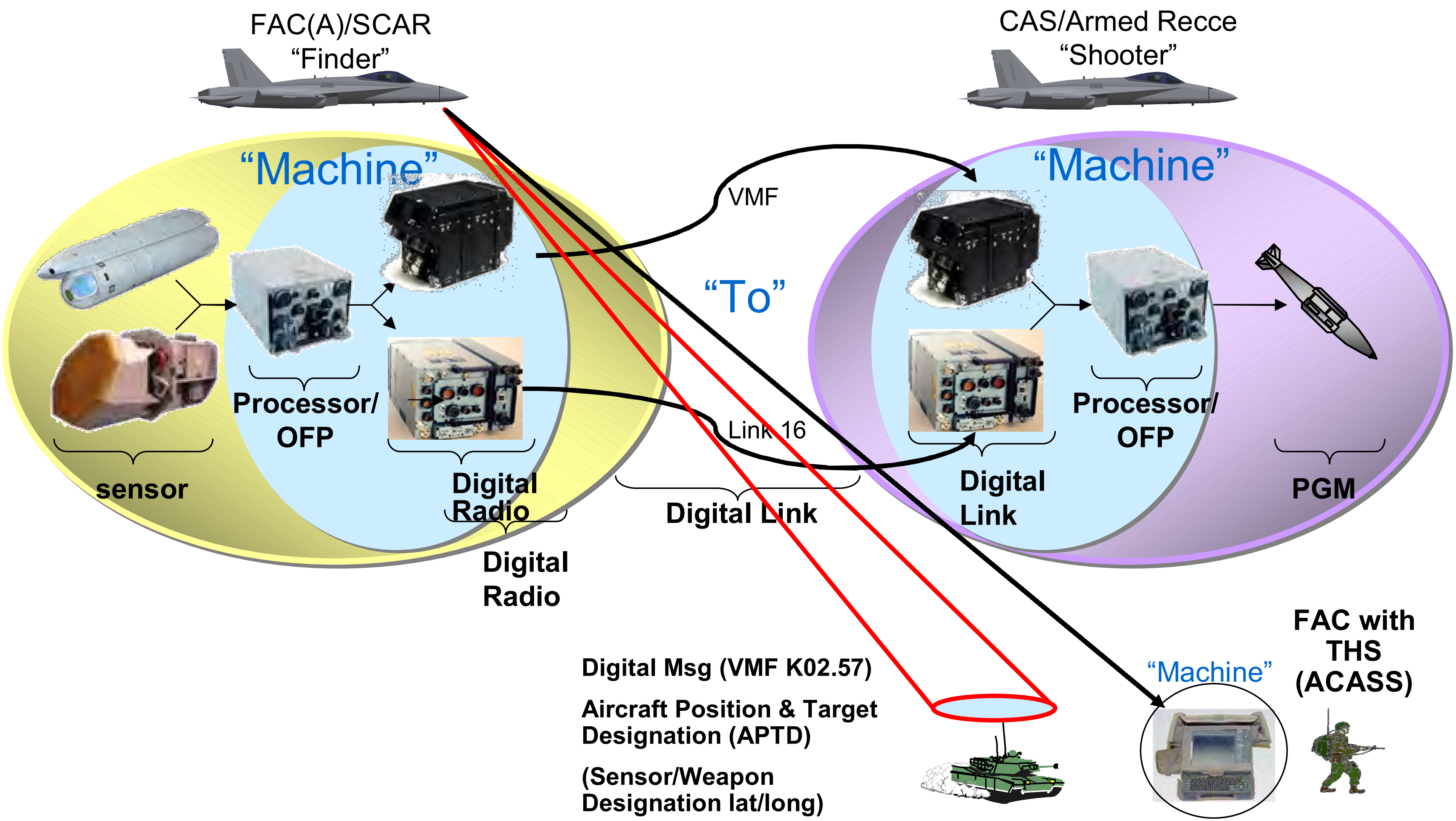
Today's F/A-18 Interoperability Capabilities

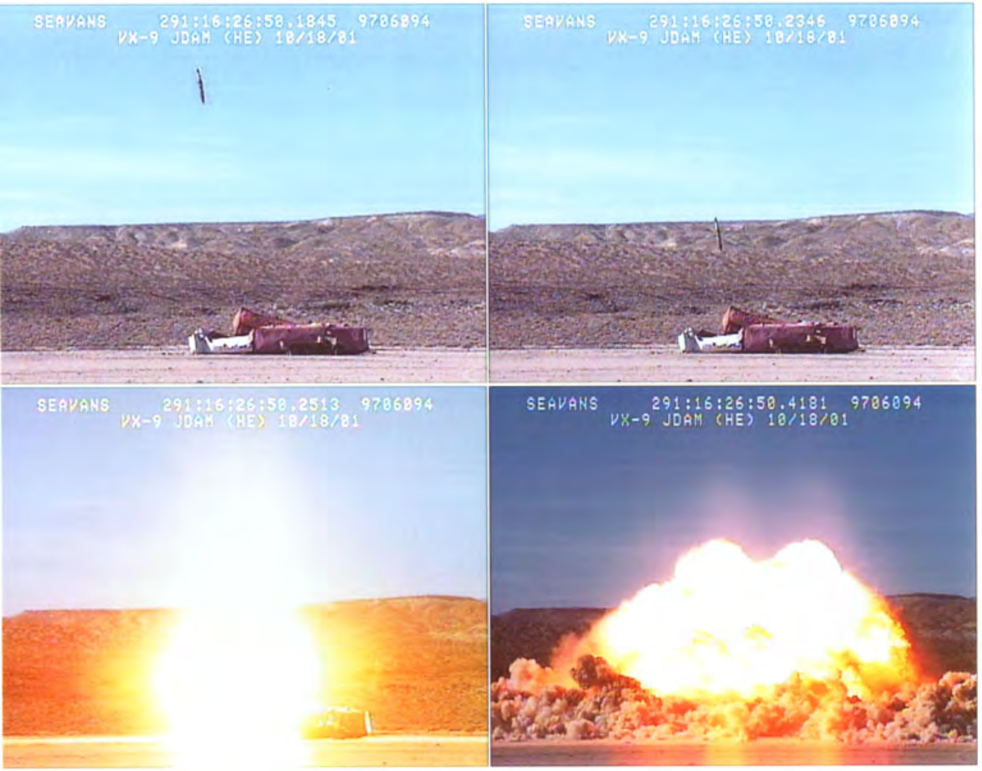
Current F/A-18 INTEROPERABILITY = LINK-16 + VMF + CDL



LINK	Mil-Std
CDL	Mil-Std-7681990
L16	Mil-Std-6016
VMF	Mil-Std-188-220

Net Centric in F/A-18





VMF

F/A-18 Providing Better Close Air Support

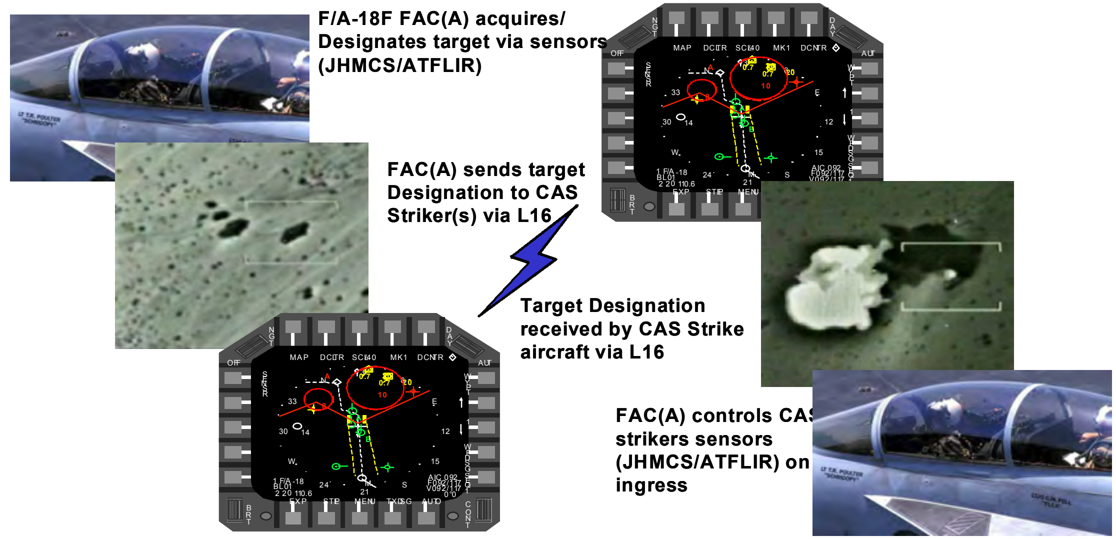
VMF Status and System Synopsis

- Program development started in mid-1990s
- F/A-18 Initial Operating Capability (IOC) in 2003
  - Included with 17C/18E OFPs
- 400+ VMF-capable aircraft currently in the Fleet (with DCS radio)
  - It will be the most numerous fielded & commonly configured TACAIR VMF data link
  - DCS Retrofits to fleet aircraft will be on-going for next 3 to 4 years
- Fleet will have 1000+ VMF-capable aircraft when DCS retrofits are completed
  - Approximately 500 C/D, 100 A+, and 460 E/F aircraft
- U.S. coalition nation aircraft also planning to field VMF per the F/A-18 configuration
  - Australia, Canada, United Kingdom

Simplified F/A-18 A+/C/D/E/F VMF Implementation

- Entire Fleet VMF Capabilities are Identical Today: OFP 17C (A+,C,D), OFP 18E (First Super Hornets), OFP H2E (Newer Super Hornets)
  - 1st spiral digital CAS
  - Messages per VMF TIDP-TE Reissue 2 (same as 15C)
  - K01.01 (Free Text); K02.33 (CAS 9-line Brief); K02.34 (Aircraft On Station); K02.35 (Departing Initial Point)
- Entire Fleet Software Upgrade in Fall 2005: 19C (A+, C/D) & H2E+ (Super Hornets)
  - 2nd spiral digital CAS
  - Messages per VMF TIDP-TE Reissue 6
  - Three new messages
    - K02.57 (Aircraft Position & Target Designation - APTD); K02.58 (Final Attack Control); K02.59 (Request APTD)
  - New Imagery K (H2E+ only)
- Future Fleet Software Upgrade in Fall 2006: H3E & 20X ICPs to MIL-STD-6017
    - 3rd spiral digital CAS
    - Update K02.28 CAS Bomb Damage Assessment (BDA) message
    - Update K02.33 CAS 9-line & K02.57 APTD message

MIDS (Link-16) Status



MIDS Highlights

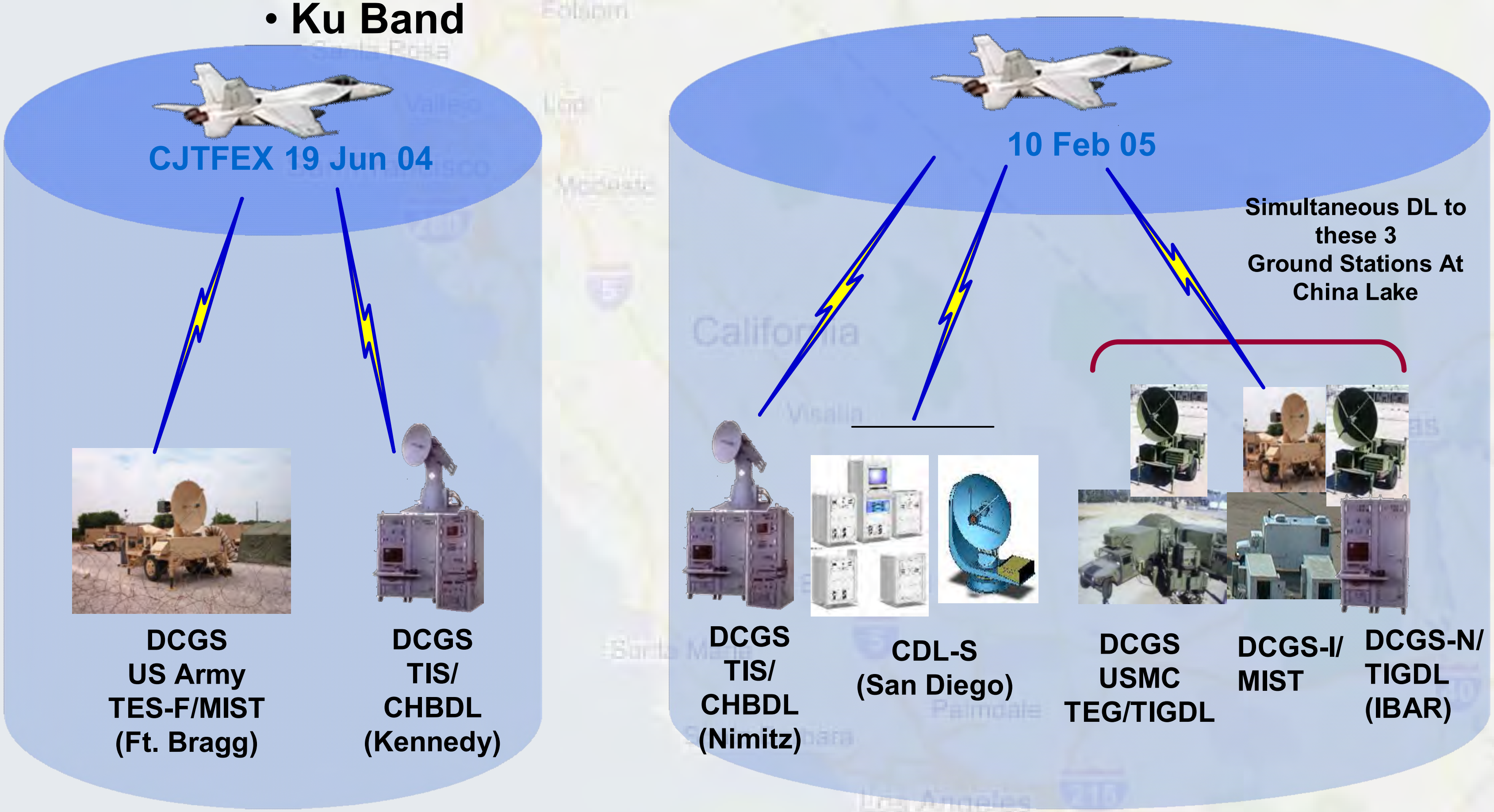
- VFA-131 (deployed on USS GW) Reports: "… Voice A (16 kBPS) functions excellently as a Tactical Net, and in many cases has worked better than HQ or KY."
- **24** F/A-18 Squadrons have **163** MIDS-LVTs installed
- MIDS flown over **12,000** flight hours in EOC squadrons **during Operation Iraqi Freedom.** **30,061** Fleet Flight Hours (as of Jun04)
- MIDS Squadrons currently deployed on **3 Carrier Battle Groups: USS JFK, USS Stennis, USS Kitty Hawk**
- MIDS Exceeding Reliability Expectations with Fleet MTBF of **825** Hrs

- **Machine-to-machine**
- **No voice required**
- **Shortens kill chain**

Navy MIDS-LVT(1) Approved for Full Rate Production

F-18F SHARP Wideband CDL to DCGS Ground Stations

- Wideband 247 Mbps CDL format data link
- 100’s to1000’s of NITF images are sent on each mission
- Ku Band



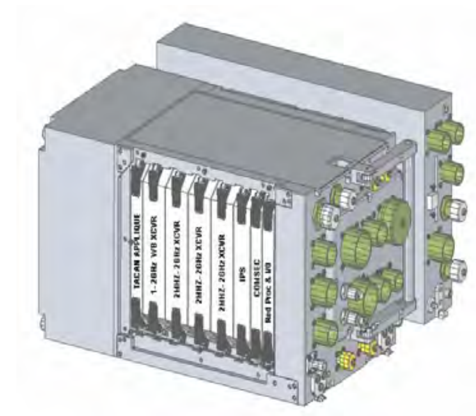
DCGS Compatible Ground Stations

MIDS JTRS

MIDS-LVT (1 Channel)

Link-16, J-Voice, and TACAN

Location in F/A-18 Avionics Bay



MIDS JTRS (4-Channel)

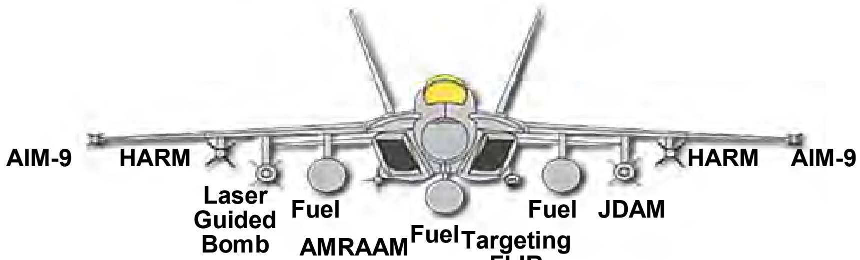
- Link-16, J-Voice & TACAN on Channel #1
- 3 JTRS universal channels (Channels 2-4)
  - 2 MHz - 2 GHz capability
  - Programmable with any JTRS Waveform

**"Plug and Play" Replacement,
Form Factor Compliant**

UAV Data Link in Targeting Pod OIF Video

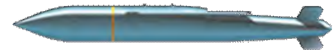
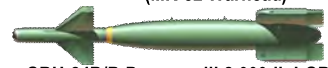
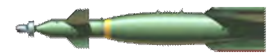
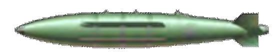
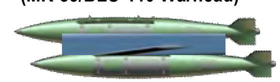
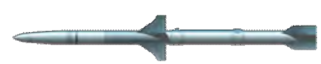
F/A-18E/F Multi-Mission Weapons Flexibility

Air-to-air payload



Precision strike with self-escort/self-protection

Current F/A-18E/F Capability	
AIM-7 Sparrow	JDAM Mk84/BLU-109
AIM-9L/M Sidewinder	JSOW-A (Baseline)
AIM-120AB/C AMRAAM	GBU-10/12/16
M61 Cannon	AGM-88 HARM
	Mk-82/BLU-111
Refueling Pod	MK-83/ BLU-110
NAVFLIR/TFLIR/ATFLIR	MK-84
ALE-47 Chaff/Flare	CBU-99/100
ALE-50 Towed Decoy	AGM-65 Maverick
TACTS Pod	AGM-84D Harpoon
AWW-13 DL Pod	AIM-84E SLAM
	BDU-45/48, Mk76
	BDU-48 / LGTR

Weapon	IOC/Remarks
 AIM-120 C5/6	Deployed
 AGM-154 C JSOW Glide Bomb	Deployed
 GBU-12 Paveway II 500-lb LGB (MK-82 Warhead)	Deployed
 GBU-24B/B Paveway III 2,000-lb LGB	Deployed
 GBU-16 Paveway II 1,000-lb LGB (MK-83 Warhead)	Deployed
 AIM-9X Sidewinder	July 2005
 GBU-38 JDAM 500-lb (MK-82 Warhead)	August 2005
 AIM-120D	2008
 GBU-32 JDAM 1,000-lb (MK-83/BLU-110 Warhead)	2008
 BRU-55 Dual Carriage Rack 1760 & Non-1760 Capable	2008
 Dual Mode LGB (GBU-12/16)	2008
 AGM-88E AARGM	2009

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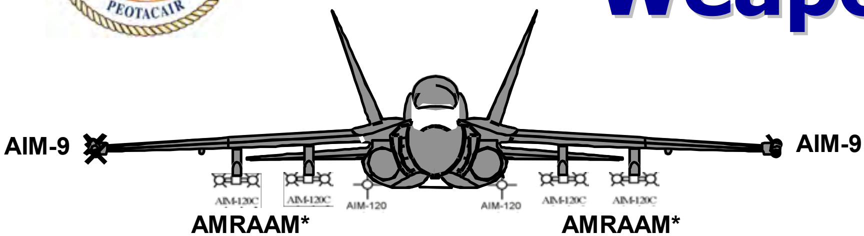
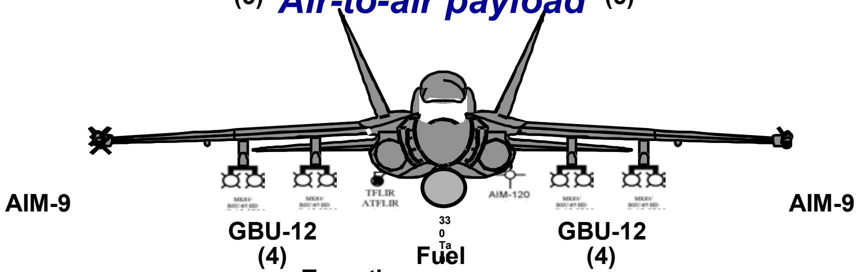
F/A-18 A+/C/D Multi-Mission Weapons Flexibility



Air-to-air payload



Precision strike with self-escort/self-protection

Current F/A-18A+/C/D Capability	
AIM-7 Sparrow	JDAM Mk84/BLU-109
AIM-9M Sidewinder	JDAM Mk83/BLU-110
AIM-120AB/C AMRAAM	JSOW-A (Baseline)
M61 Cannon	GBU-10/12/16
LAU-10 5in Rockets	GBU-24B/B
LAU-61 2.75in Rockets	AGM-88 HARM
NAVFLIR/TFLIR/ATFLIR	Mk-82/BLU-111
ALE-47 Chaff/Flare	MK-83/ BLU-110
TACTS/LATR Pod	MK-84/BLU-117
AWW-13 DL Pod	CBU-78/99/100
ADM-141 TALD	AGM-65E/F Maverick
LUU-2 Paraflares	AGM-84D Harpoon
Mk52/55/56/58/62 Mines	AIM-84H/K SLAM ER
Mk77 Fire Bomb	BDU-45/48, Mk76
PDU-5 Leaflet Bomb	BDU-48 / LGTR
	EW Pods

Weapon	IOC/Remarks
AIM-120 C5/6	Deployed
AGM-154 C JSOW Glide Bomb	Deployed
GBU-12 Paveway II 500-lb LGB (MK-82 Warhead)	Deployed
GBU-24B/B Paveway III 2,000-lb LGB	Deployed
GBU-16 Paveway II 1,000-lb LGB (MK-83 Warhead)	Deployed
AIM-9X Sidewinder	Deployed
GBU-38 JDAM 500-lb (MK-82 Warhead)	Deployed
GBU-32 JDAM 1,000-lb (MK-83/BLU-110 Warhead)	Deployed
AIM-120D	2008
BRU-55 Dual Carriage Rack 1760 & Non 1760 Capable	2008
Dual Mode LGB (GBU-12/16)	2008
AGM-88E AARGM	2009

Weapons in the Fight

- AIM-9X
- GBU-12 OB
- GBU-38
- BRU-55
- SLAM-ER

BRU-55 Smart Rack

Description: BRU-55 is a BRU-33/A with electronics upgrades which allows carriage and release of two MIL-STD-1760 weapons from a single aircraft station.

Permits carriage of two 1760 weapons off single wing pylon

Status / Accomplishments:

- F/A-18C/D – successful SCS 19C1 DT Flight Tests. 8 x J-82s dropped.
- BRU-55 Production contract awarded to EDO
- PMA-201/265 agreed to implement BRU-55 Dual Mode (1760 and conventional weapons)
    - Rewiring EBF power supply to support conventional weapons.
- BRU-55 Dual Mode SCS implementation for F/A-18A+/C/D is (21X) & F/A-18E/F is (H-4E)

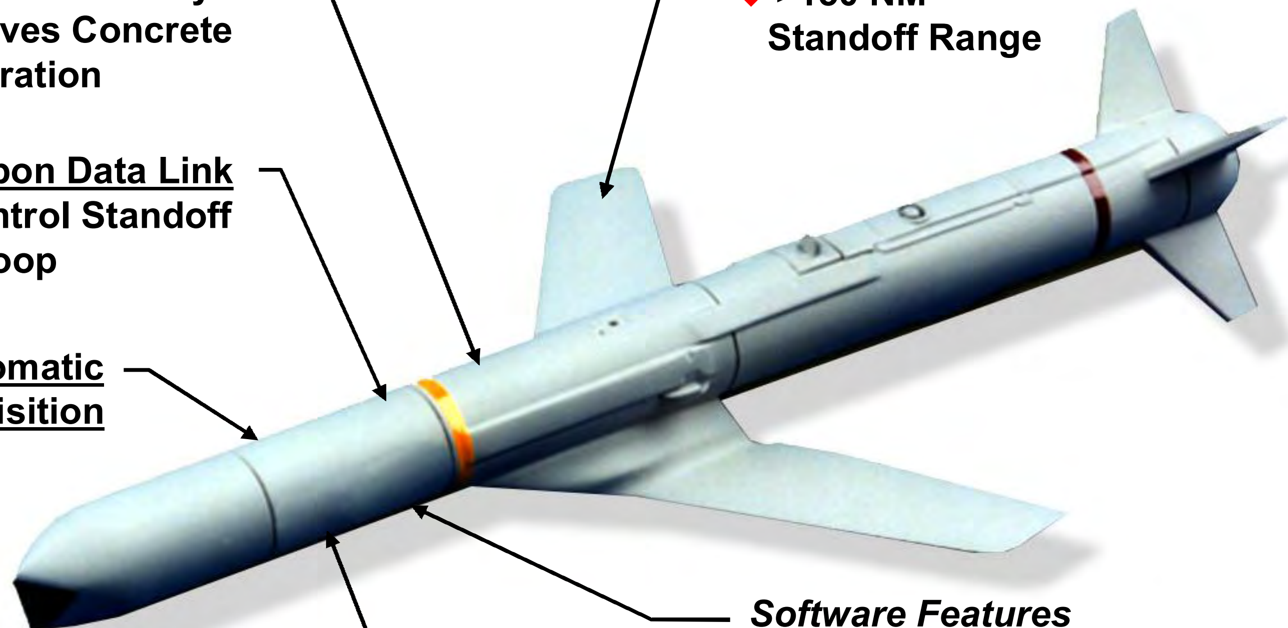
SLAM-ER
Improvements over SLAM

<u>Tomahawk-Derivative Penetrating Warhead</u>
- With 3 Fuze Delays
- Improves Concrete Penetration

<u>Tomahawk-Derivative High Lift-to-Drag Planar Wings</u>
- >150 NM Standoff Range

<u>Advanced Weapon Data Link</u>
- Improves Control Standoff
- Man In The Loop

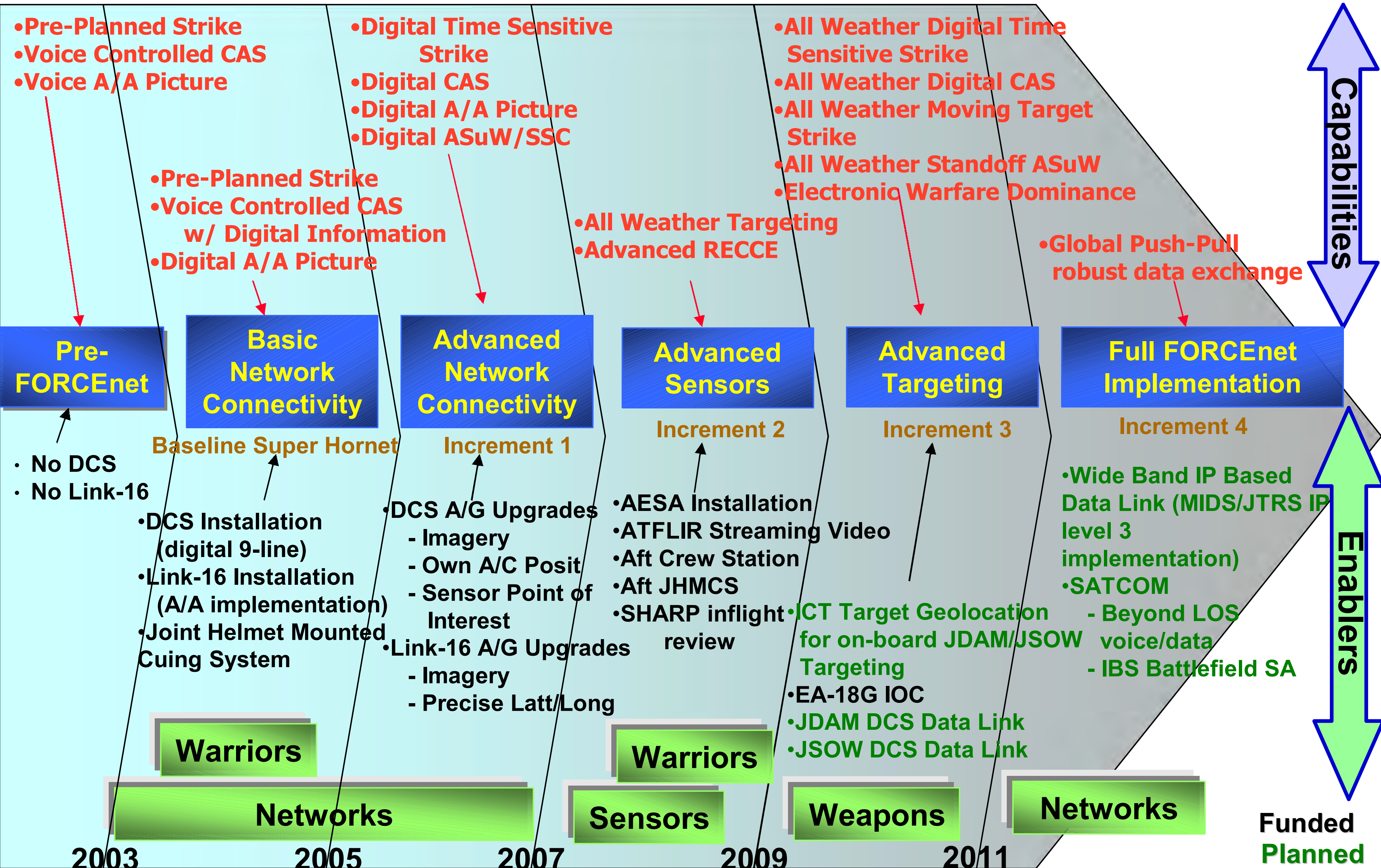
<u>Automatic Target Acquisition</u>



<u>Guidance Navigation Unit</u>
- 5 Channel GPS
- RLG Based INS
- MIL-STD 1760 Interface

<u>Software Features</u>
- Adaptive Terrain Following
- Improved Terminal Guidance
- Energy Management
- Improved Ship Target Acquisition
- Smart Mission Planning
- Re-locatable Targets (2003)
- Moving Land Target (2005)

Incremental F/A-18 FORCEnet Implementation



NCO Demonstrations

√ **VMF Imagery**
Sent targeting data and imagery to FAC using DCS radio and ACASS
Dec 2002

√ **Link 16 Imagery**
Passed targeting and imagery between C^2 node and the F/A-18
4 Sept 2003

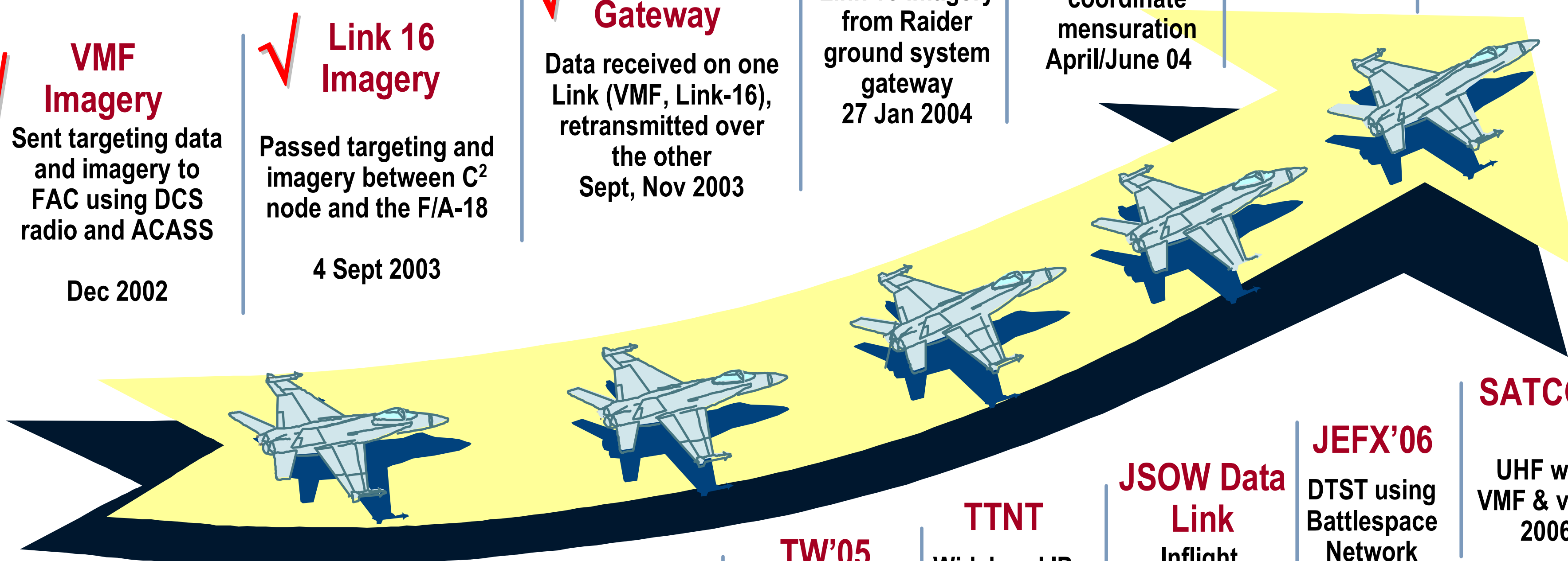
√ **VMF-Link 16 Gateway**
Data received on one Link (VMF, Link-16), retransmitted over the other
Sept, Nov 2003

√ **RAIDER**
Link 16 imagery from Raider ground system gateway
27 Jan 2004

√ **Onboard Target Geolocation**
Automated Target coordinate mensuration
April/June 04

√ **MADD**
Maintenance Data Downlink via Link 16
June 2004

√ **JEFX'04**
VMF/ Link16 Digital TST
2004



JDAM Data Link
Inflight updates using VMF
2005

TW'05
Maritime Digital TST
2005

TTNT
Wideband IP Connectivity
2005

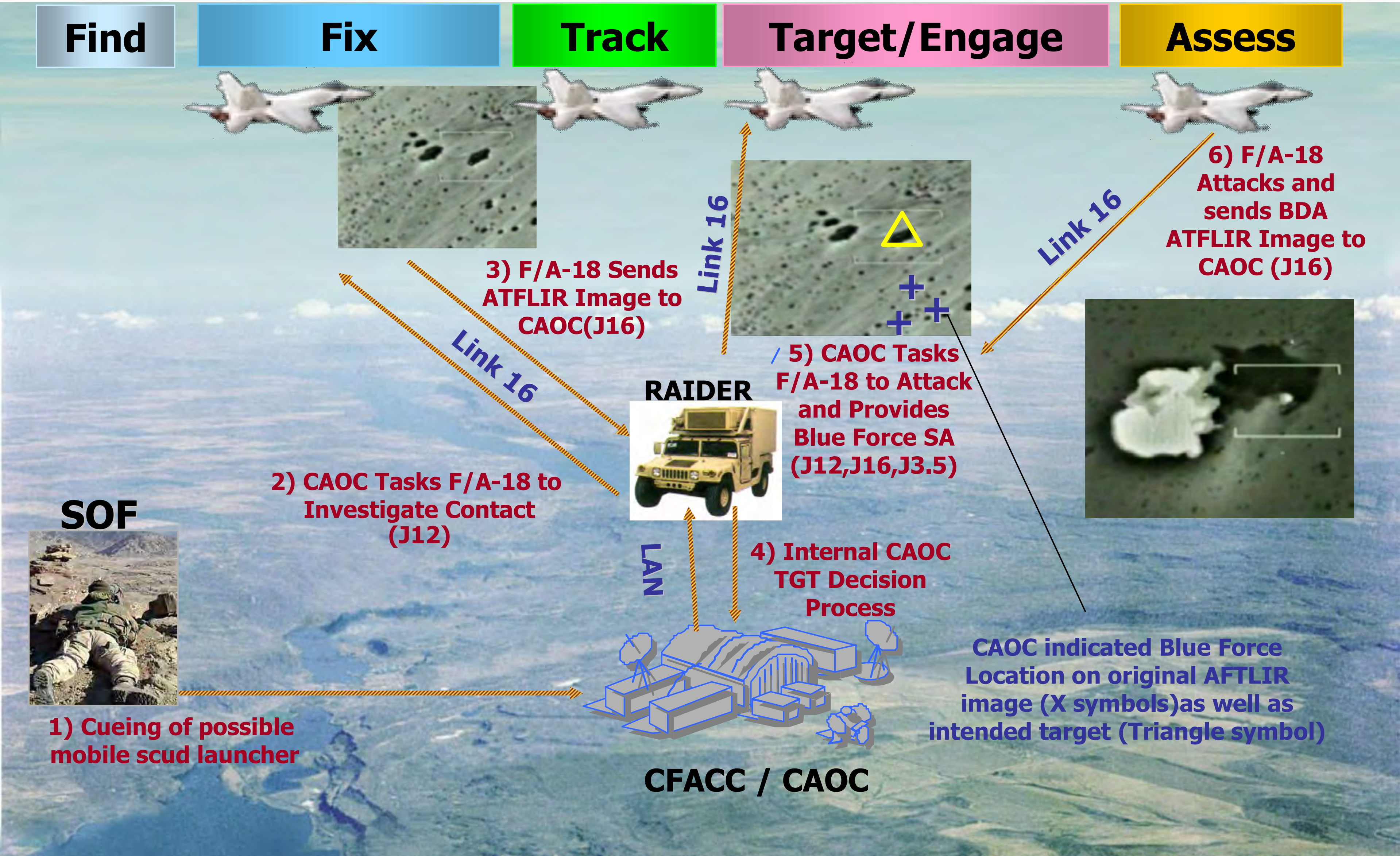
JSOW Data Link
Inflight Updates using VMF
2005

JEFX'06
DTST using Battlespace Network
2006

SATCOM
UHF with VMF & voice
2006

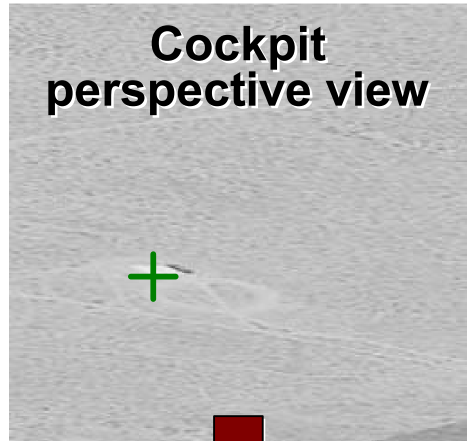
NAVAIR

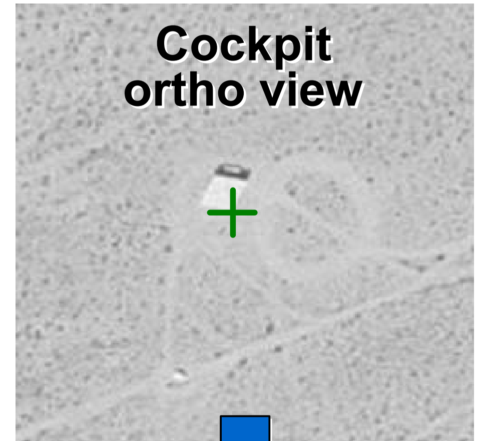
Joint Digital Time Sensitive Targeting (JEFX-04 Experiment)

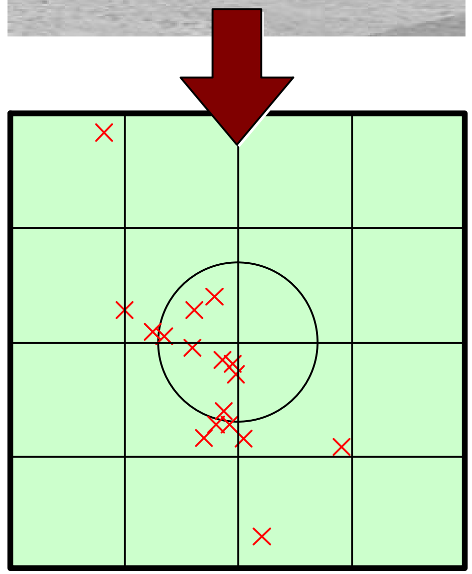


Digital Close Air Support
(Army Fort Dix Sep 04 Demonstration)

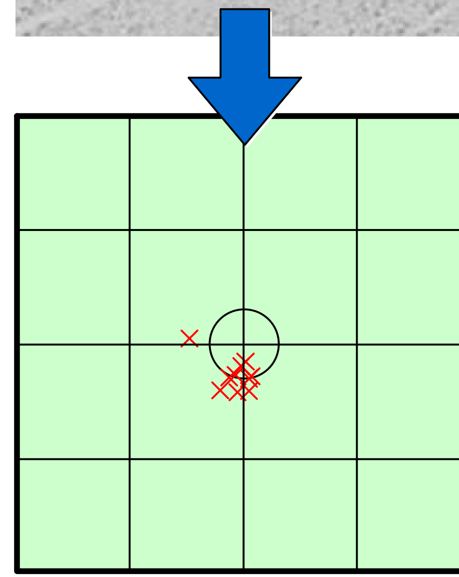
ICT Flight Test Results Against ALAST Board







Geo-registration results

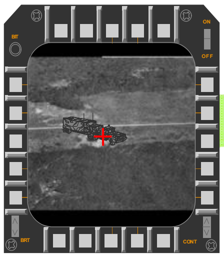


Pilot updated designation from ortho view

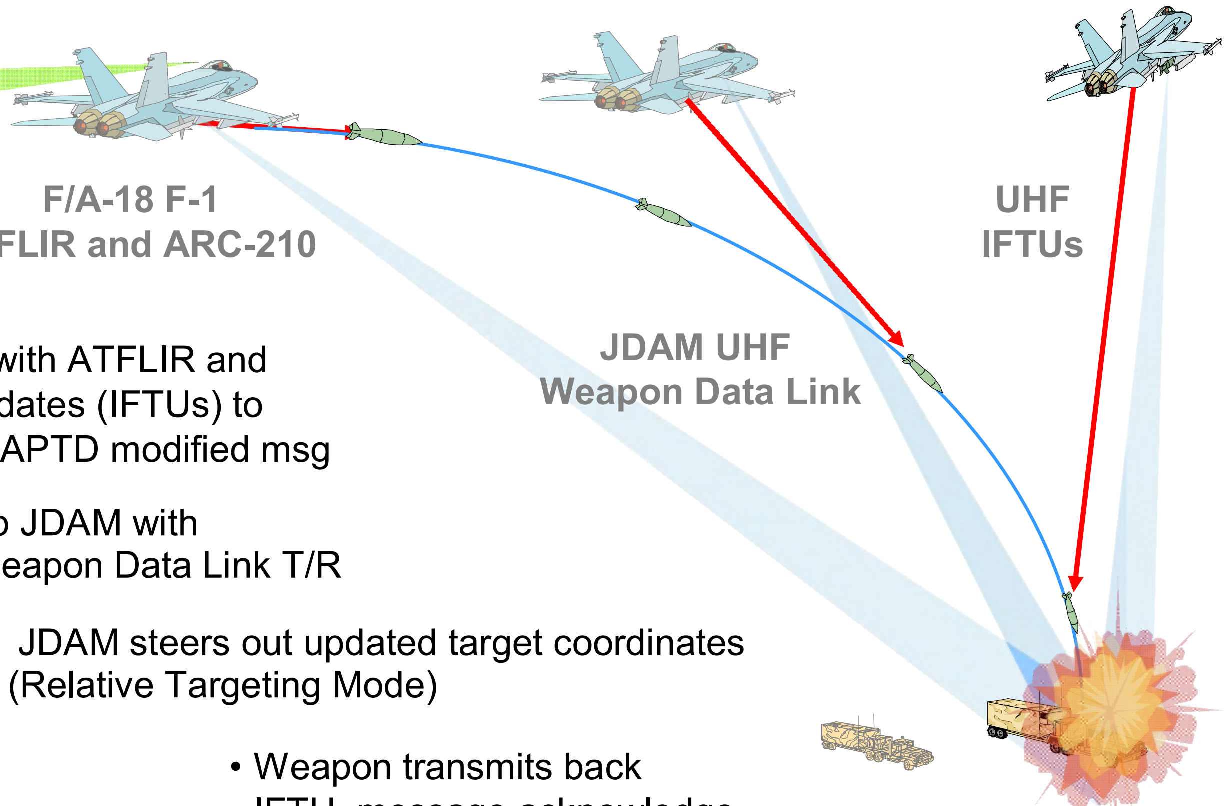
Note: Tested against over 12 different target sets, but truth data was only available for the ALAST target board shown here

Proposed ICT Memory: 125 - 500 GB
Proposed ICT Processing: 32 GFLOPS
Geolocate, Moving Tgt, Target Cueing, ATR

F/A-18 F-1 JDAM MTE Demo



ATFLIR single MTT



- Hornet tracks moving target with ATFLIR and transmits In-Flight Target Updates (IFTUs) to JDAM via DCS VMF K02.57 APTD modified msg

- MK-84 2000 lb JDAM with Harris UHF Weapon Data Link T/R

- JDAM steers out updated target coordinates (Relative Targeting Mode)

- Weapon transmits back IFTU message acknowledge

- Constant speed and heading target

Guided Release Results

Parametric	Objective	G-1 Results
WDL IFTU update rate	> 1.5 Hz	1.5 Hz
WDL data latency	< 1.0 sec	< 1.35 sec
WDL message reception (drop rate)	< 2%	< 2%
WDL 2-way communication	performed	Yes
WDL reception range	> 40 nm	38 nm*

MTE System Miss Distance

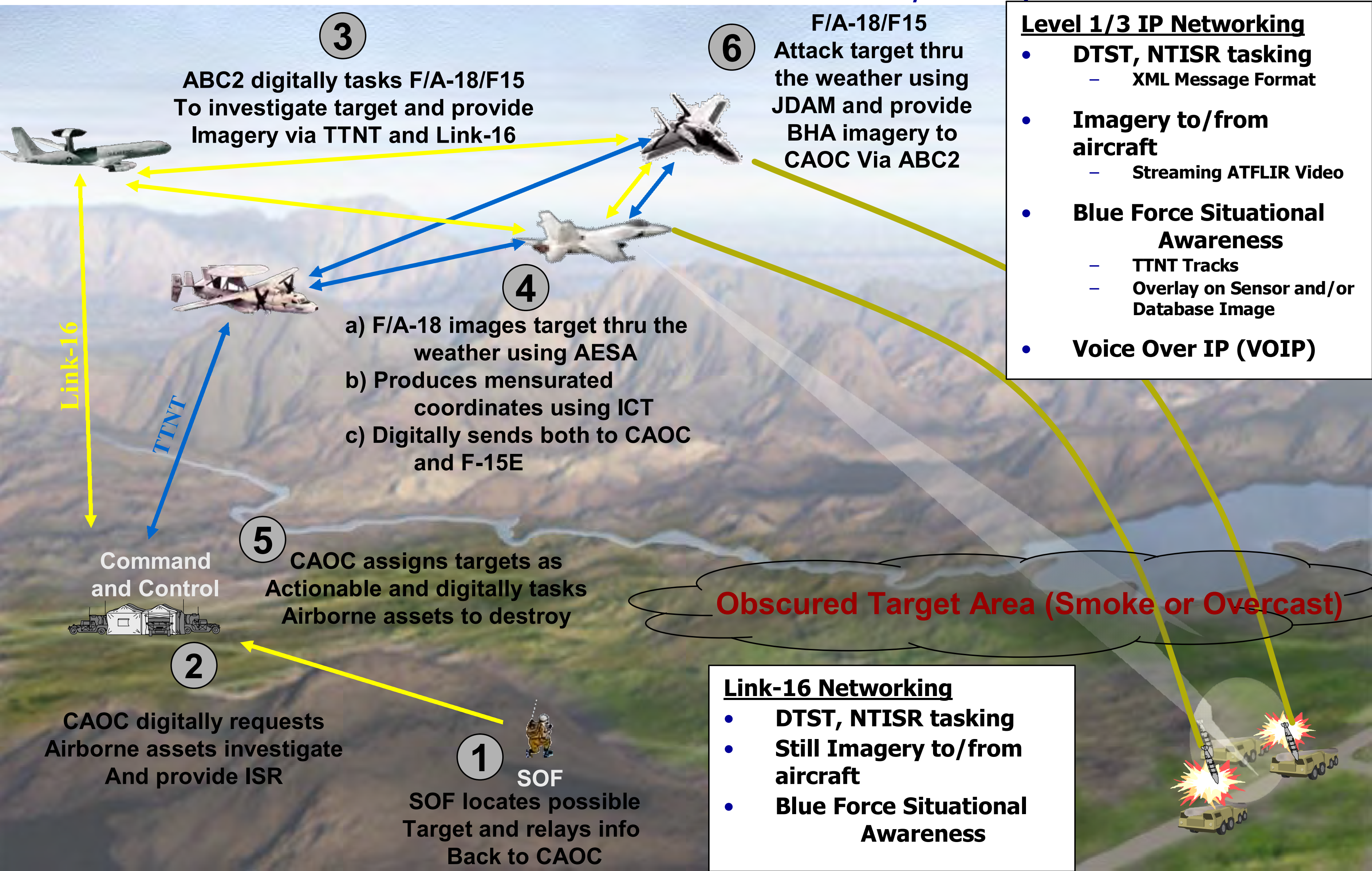
Objective	< 8 m CEP(50%)
G-1 Results	< 2 m **

* Local flight data

** Target Miss Distance is < 2 m;
MTE System Miss Distance relative to targeting point is TBD

Joint All Weather DTST

(Proposed JEFX-06 Experimentation using today's Link-16 and tomorrow's IP Network/TTNT)



F/A-18 & EA-18G PROGRAM

John.k.martins@navy.mil
work- 301-757-7583
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NAVAIR

TDW Gesellschaft für verteidigungstechnische Wirksysteme mbH

Accelerating Precision Strike Technology for Stability Operations and Protection of Coalition Forces

EADS DEFENCE & SECURITY

Penetrating Effector Systems from EADS / TDW

Dr. Helmut Muthig
President & CEO
EADS / TDW

October 18, 2005

Precision Strike Technology Symposium
PSTS – 05

Kossiakoff Conference Center
The Johns Hopkins University
Laurel, Maryland

Who we are

TDW

is

Europe's No. 1

in

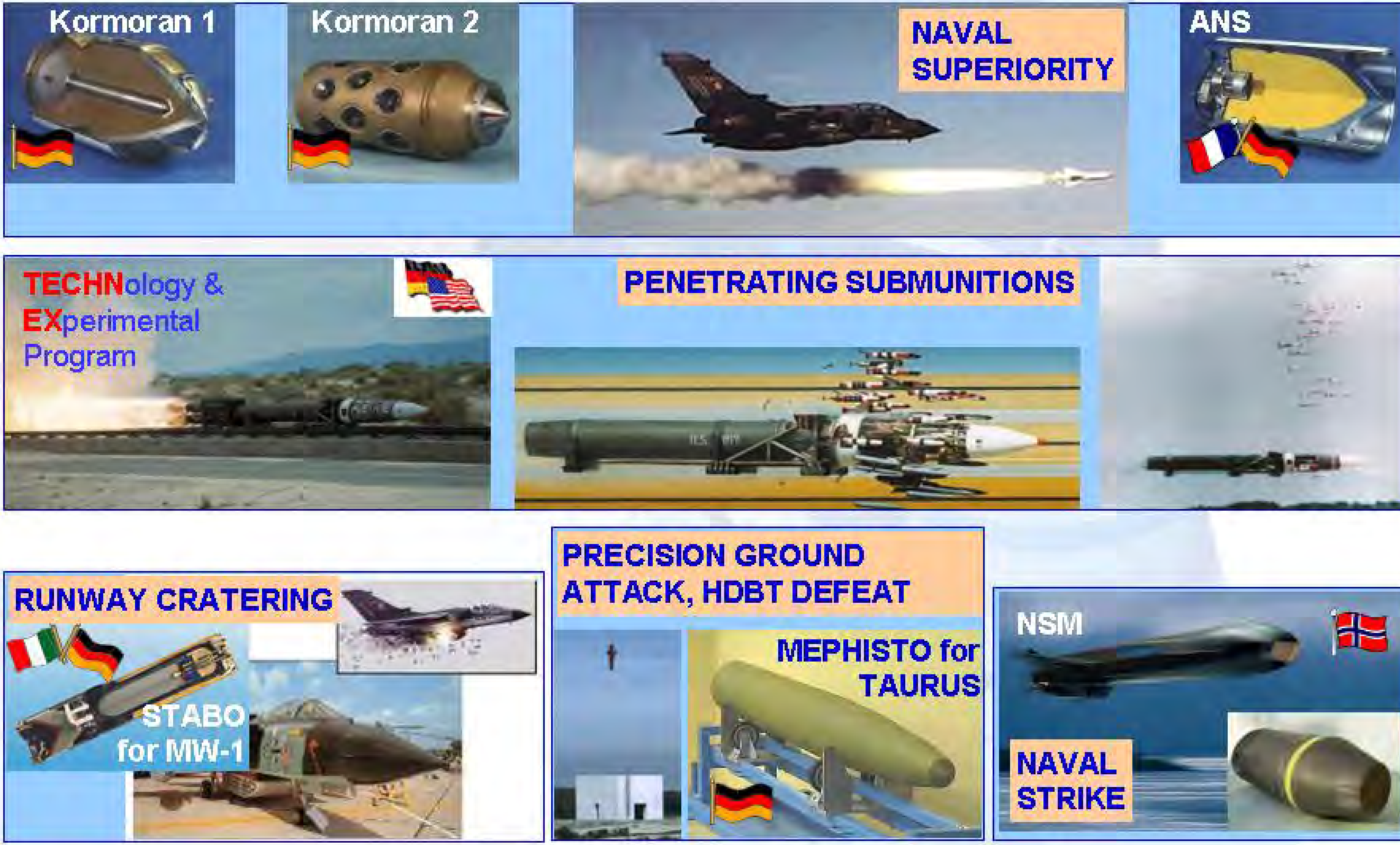
"Penetrating Effector Systems for Guided Weapons"

and is on the way to the

U.S.

EADS DEFENCE & SECURITY

TDW = Three decades of Penetrating Effectors



TDW = An EADS Company

TDW Gesellschaft für verteidigungs-technische Wirksysteme mbH

is the acknowledged *"Center of Excellence"*
for *"Lethal Packages"* within EADS
with more than 47 years of expertise at Schrobenhausen/GERMANY

Business Unit “Missiles“ within DS: EADS / LFK
Actual Transatlantic Cooperations

MEADS

Patriot

Stinger

RAM

ESSM

Penetrating Effector Systems from EADS / TDW
Presentation Outline

Accelerating Precision Strike Technology for Stability Operations and Protection of Coalition Forces

- Introduction: Short Company Background
- The Need: Effective Defeat of Hard Targets
- One Solution: Penetrating Effector Systems from TDW
  - Q: What does it take to build effective penetrating effectors?
  - A: Penetrating Effector Capabilities from TDW!
    - Requirement Analysis and Effector System Design
    - Penetration Simulation and Performance Prediction
    - Penetrator Charge Design (Casing and High Explosive)
    - Penetrator Fuzing (Smart Hard Target Fuzing)
- Examples, Tests, Video Clips

Penetrating Effector Systems from EADS / TDW

PSA Accelerating Precision Strike Technology for Stability Operations and Protection of Coalition Forces

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- **The Need: Effective Defeat of Hard Targets**
- One Solution: Penetrating Effector Systems from TDW
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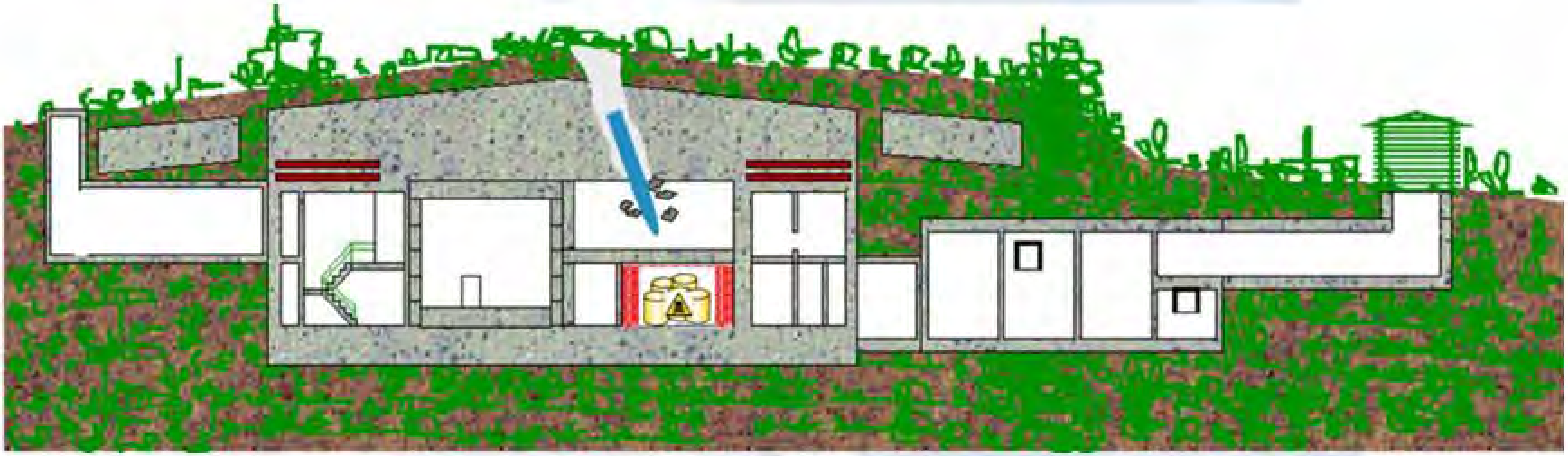
The Threat: Hard and Deeply Buried Targets



Plus a complete variety of *additional* hard targets, like:

Hardened Command and Control **Bunker**

Biological Production Facility

EW/GCI Center **Hardened** Building

Air Defense Command Center

Multi-Story Building with **Basement**

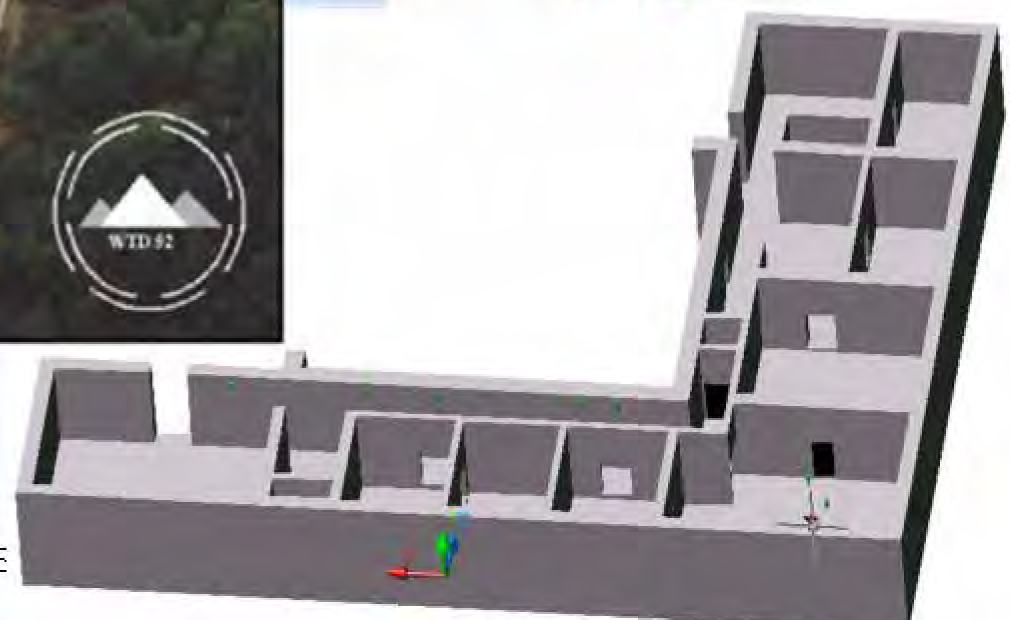
Elevator-Served Radar **Bunker**

Aircraft in **Revetments**

Aircraft Storage **Bunker** Interior

Hard Target Example: *Ladeburg* Bunker Replica at Meppen Federal Proving Ground, GERMANY

US/GE
Hard Target Defeat
Project Agreement



The Threat: Hard Sea Targets and Land Targets: *Naval Strike Missile Targets* (KONGSBERG, NOR)

- **Primary: Surface vessels**
  From small FPB to large vessels




- **Secondary: Land targets**
  Strike missions against SAM sites, C^3I Buildings, Ships in harbour




EADS DEFENCE & SECURITY

Weapon Systems with TDW's Penetrating Warheads
Actual Examples

TAURUS SYSTEMS GmbH

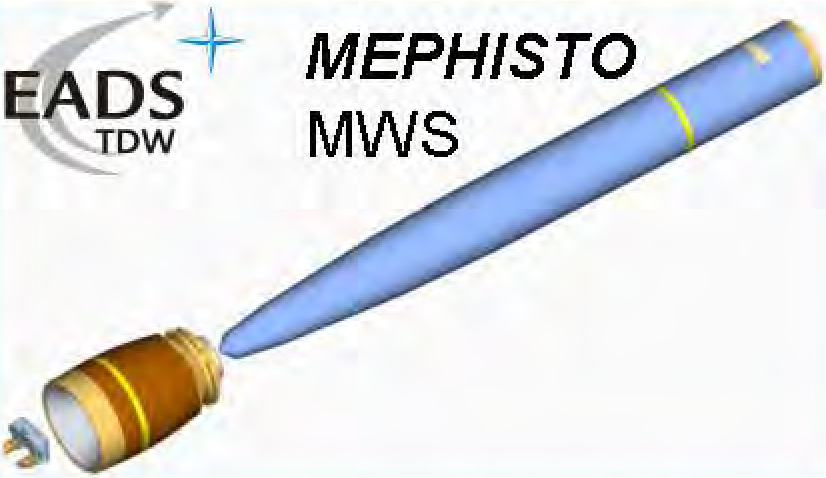
Taurus KEPD 350

Naval Strike Missile
NSM

KONGSBERG

EADS TDW

MEPHISTO
MWS



EADS TDW

New **N**SM
Warhead **NNW**

Penetrating Effector Systems from EADS / TDW
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Penetrating Effector Systems from EADS / TDW

What does it take to build effective penetrating effectors?

- Requirement Analysis and Effector System Design
- Penetration Simulation and Performance Prediction
- Penetrator Charge Design
  - Casing (Mechanical strength & Structural loads)
  - High Explosive (Performance & Insensitivity)
- Penetrator Fuzing
  - Target Detection Device (Smart Hard Target Fuzing)
  - Safe & Arm Device w/ Firing Unit

Penetrating Effector Systems from EADS / TDW

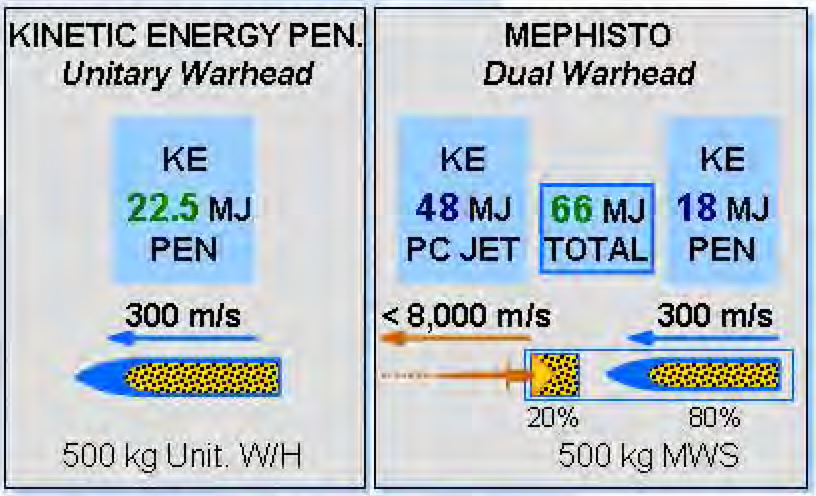
TDW

- is a "Full Service Company"
- *(from the first idea to series production)*
- is working on Effectors (warheads and fuzes) since 1958
- was formerly known as MBB, DASA
- works on one integral site (Schrobenhausen, GERMANY)
- has its own qualified high explosives
- uses its own proving ground
- is reknown in Europe
- is on the way to the U.S.

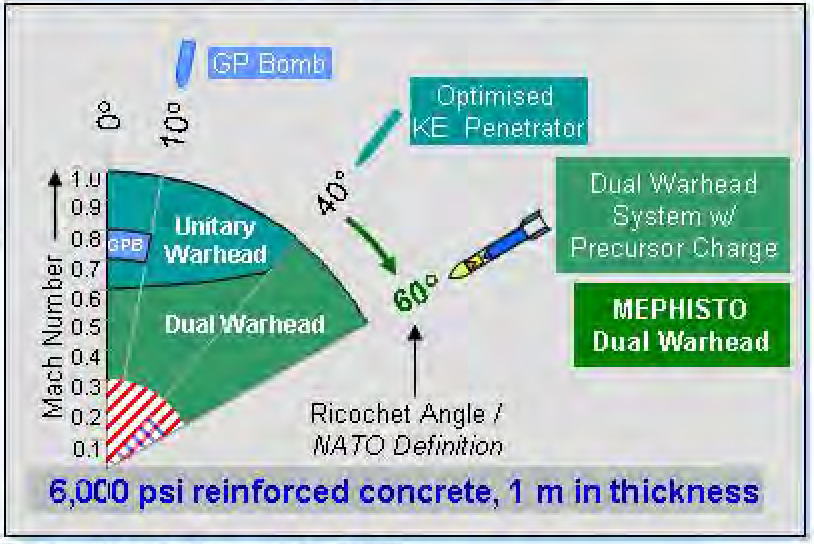
EADS North America
Defense

Requirement Analysis and Effector System Design: e.g. *Unitary Warhead vs. Dual Warhead Trade-Offs*

– System Energy Comparison



– Impact Velocity and Impact Angle Dependency



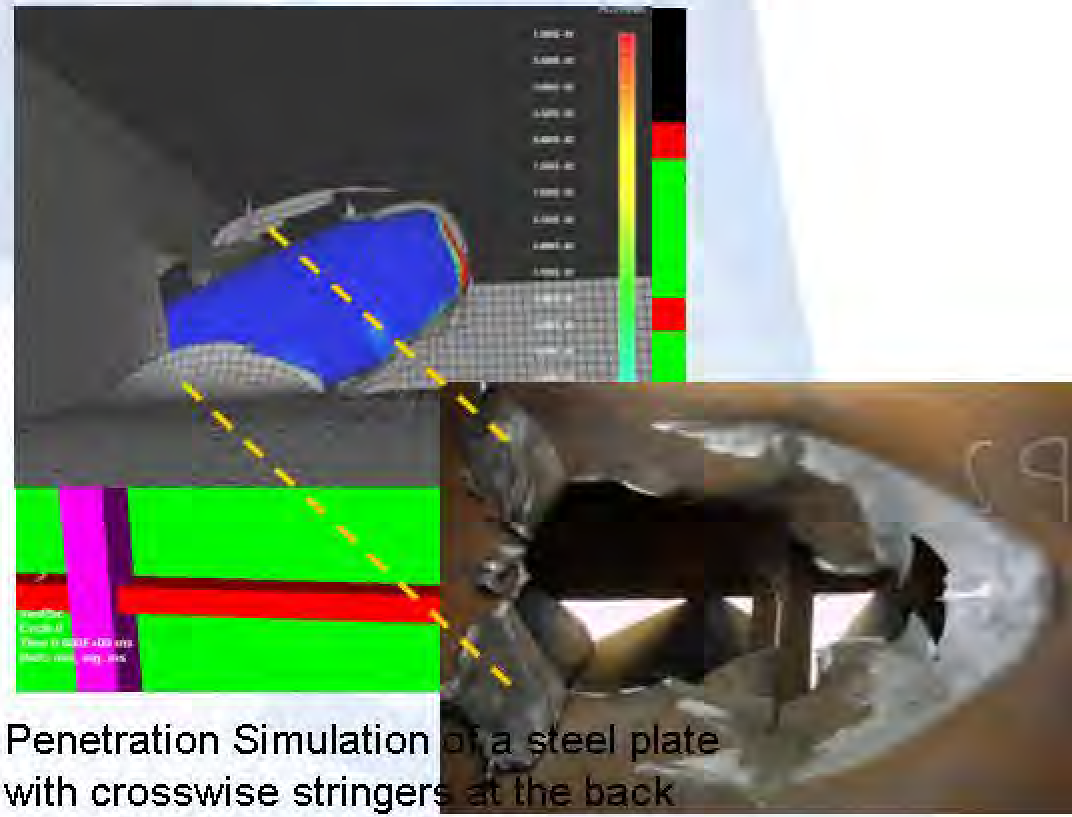
Penetration Simulation and Performance Prediction: *Homogeneous, structured and / or reinforced targets*

– Penetration Simulation

a) in Concrete *(Bunker)*

Penetration Simulation of a 40 cm reinforced concrete slab

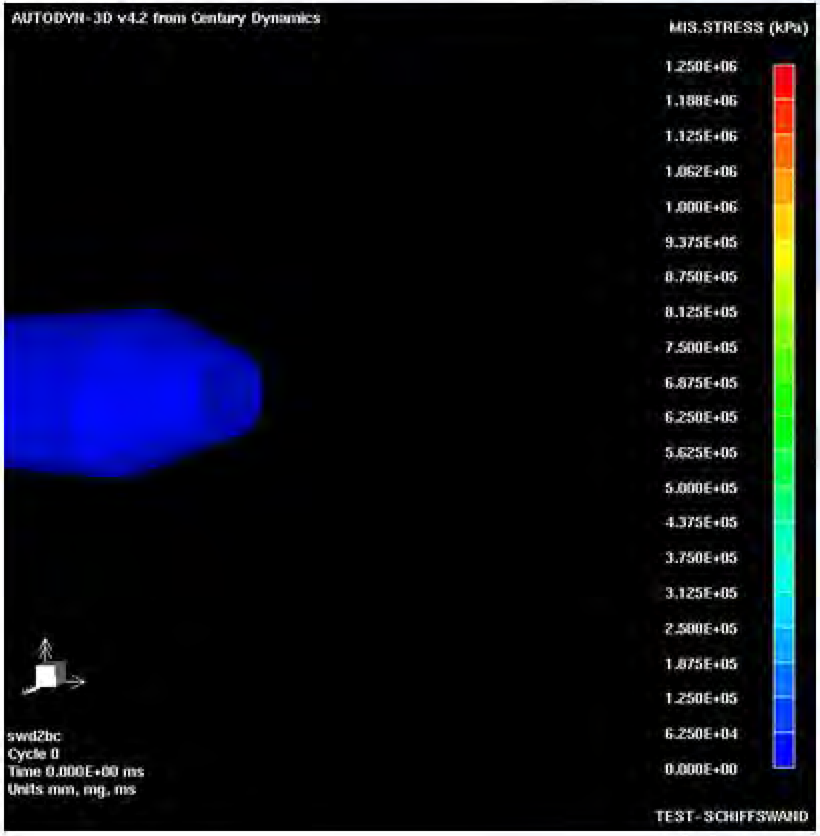
b) in Steel *(Ship Target)*

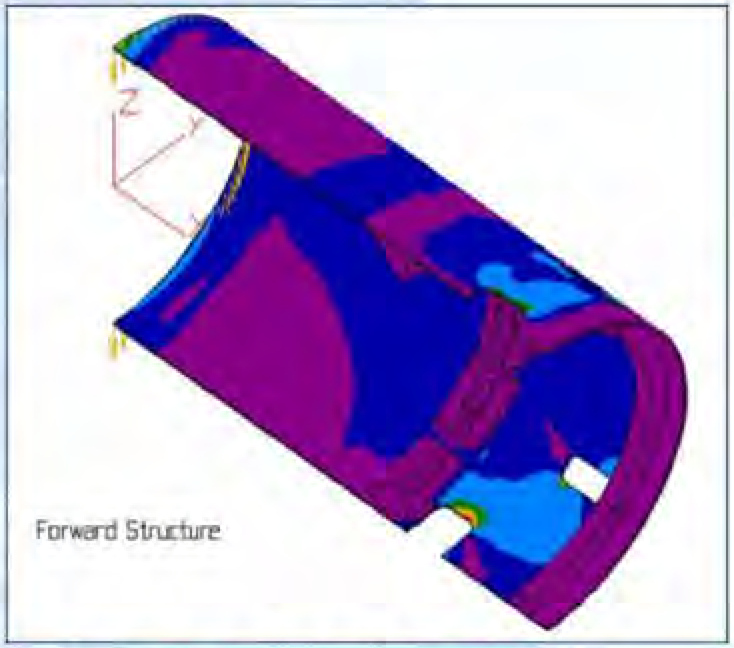


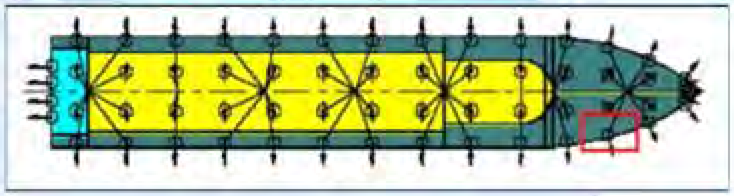
Penetration Simulation of a steel plate with crosswise stringers at the back

Penetrator Charge Design:
Casing (Strength & Structural loads)

– Structural loads simulation







Penetrator Charge Design:
High Explosive (Performance)

Results From the US/GE Test 17 Series in the Ladeburg Bunker

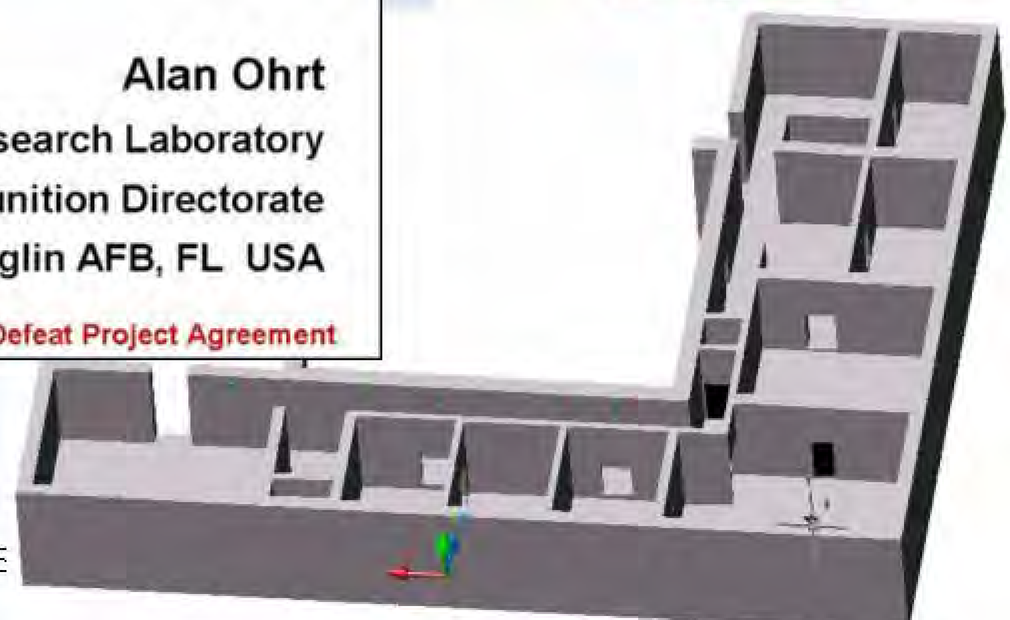
-- An Update for the March 2004 PA Meeting --

16 March 2004

Alan Ohrt
Air Force Research Laboratory
Munition Directorate
Eglin AFB, FL USA

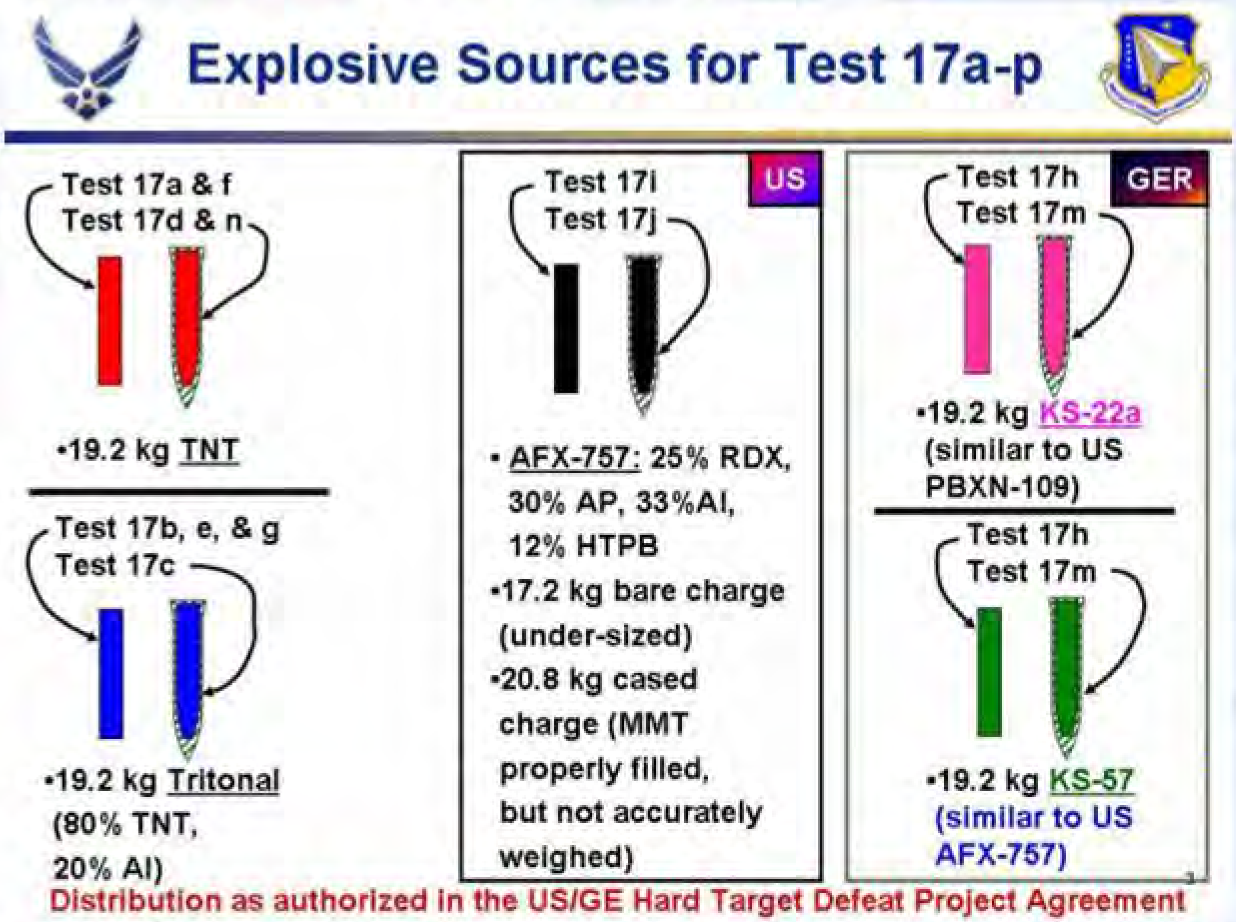
Distribution as authorized in the US/GE Hard Target Defeat Project Agreement

US/GE
Hard Target Defeat
Project Agreement



Penetrator Charge Design:
High Explosive (Performance)

– TDW's **KS22a** and **KS-57** Performance



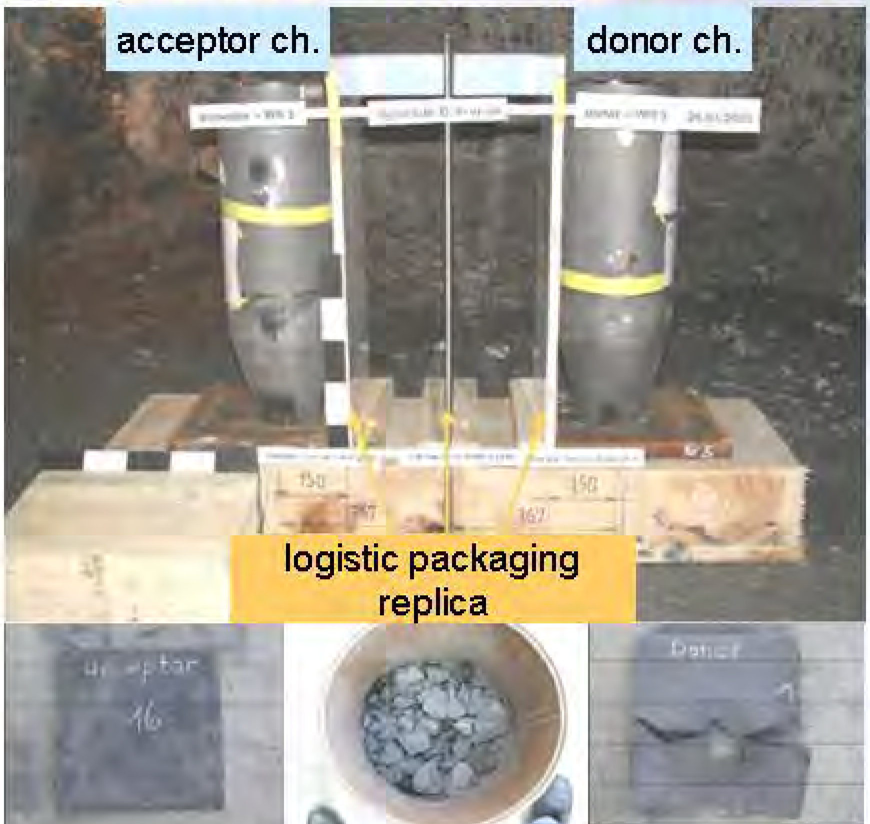
US/GE
Hard Target Defeat
Project Agreement

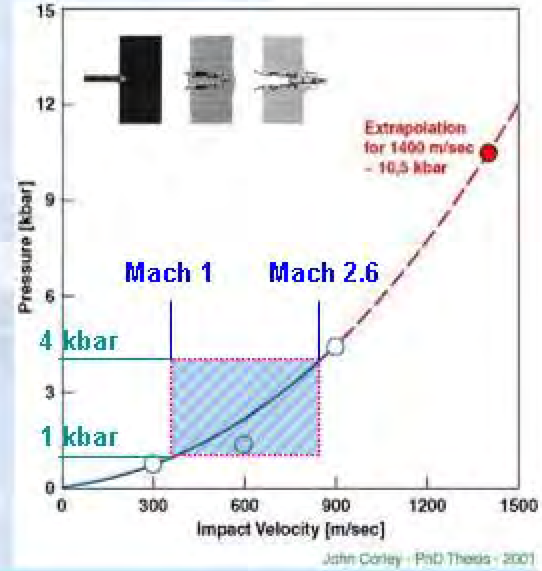
For details see AFRL report

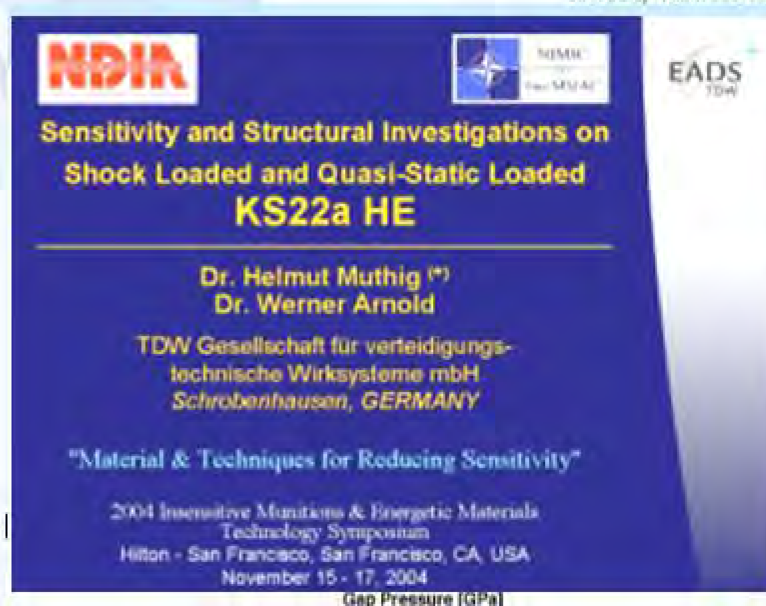
Penetrator Charge Design: *High Explosive (Insensitivity)*

– TDW's **KS22a** Insensitivity

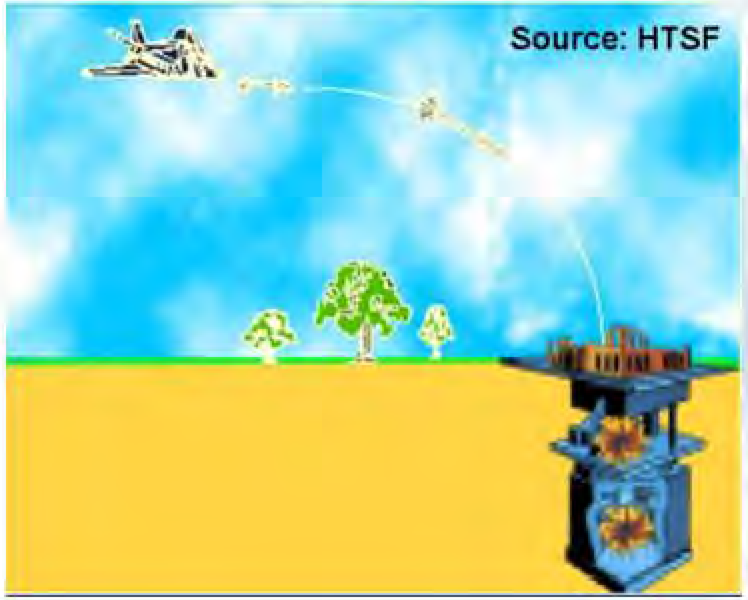
Sympathetic detonation test of NNW







Fuzing Requirement for Penetrating Warheads
Burst Point Control Fuzing



**"Smart" / Intelligent
Hard Target Fuzing =**

Burst Point Control Fuzing

Fuzing Requirement for Penetrating Warheads
Burst Point Control Fuzing

Principle Choices of a Penetrator Fuze: *"Traditional"* vs. *"Smart"* Fuzing

"Traditional"

Time delay after impact fuzing

(up to 256 different delay times, 1 msec resolution)

"Smart"

Active decision-making, burst point control fuzing

w/ **void sensing** and **layer counting** capability

vs.

Examples:

JPF (US), MAFIS (UK)

(for Storm Shadow w/BROACH)

Examples:

PIMPF (GER, ESP, NOR),

(US HTSF Requirement)

Principle Choices of a Penetrator Fuze

"Traditional"

Time delay after impact fuzing

(up to 256 different delay times, 1 msec resolution)

<u>Examples:</u>

JPF (US), MAFIS (UK)

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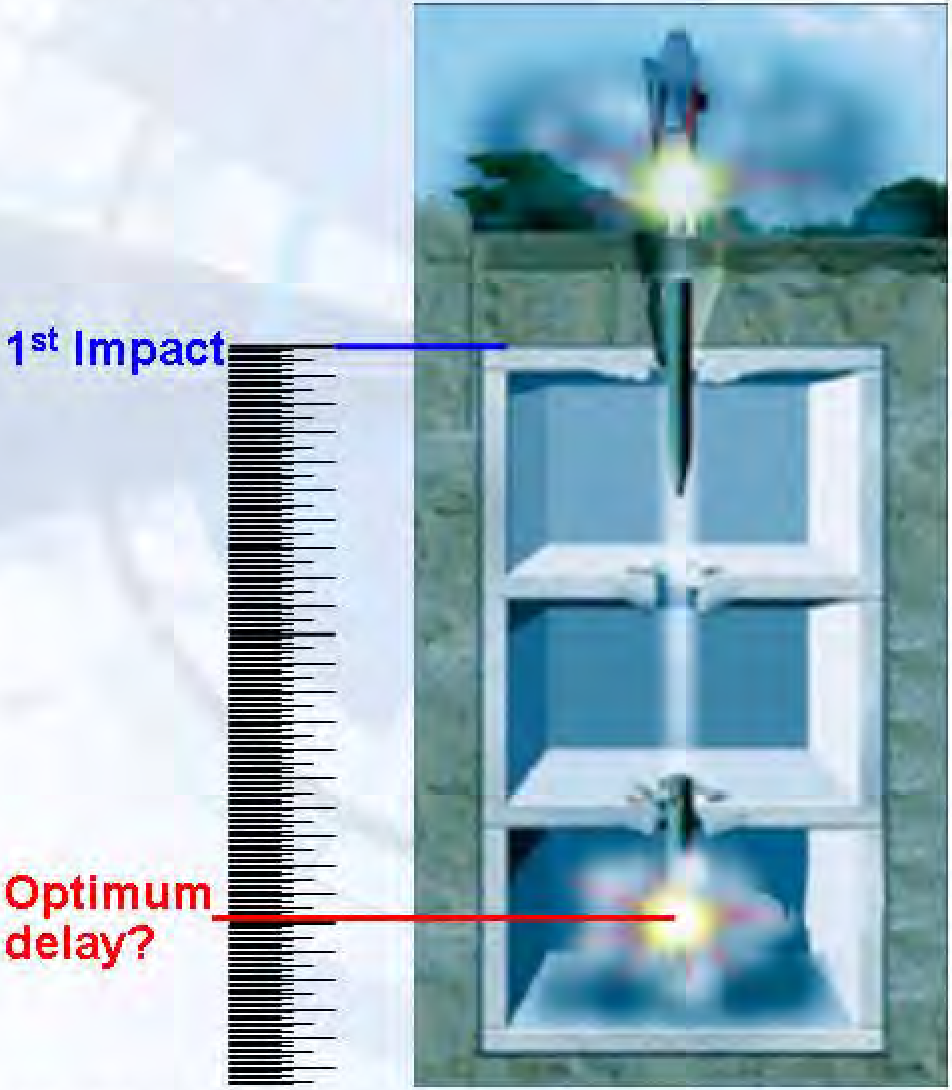
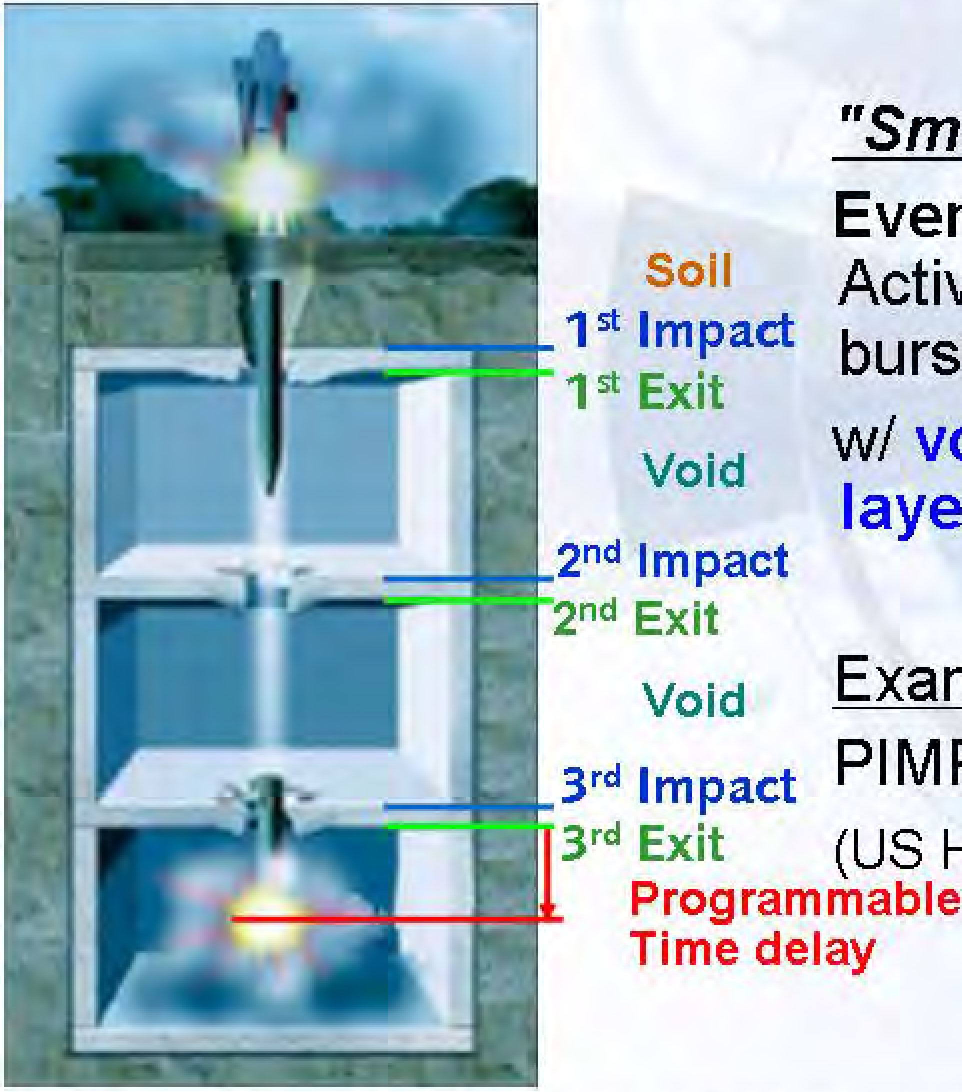


Principle Choices of a Penetrator Fuze



"Smart"

Event Detection,
Active decision-making,
burst point control fuzing
w/ **void sensing** and
layer counting capability

Examples:

PIMPF (GER, ESP, NOR)

(US HTSF Requirement)

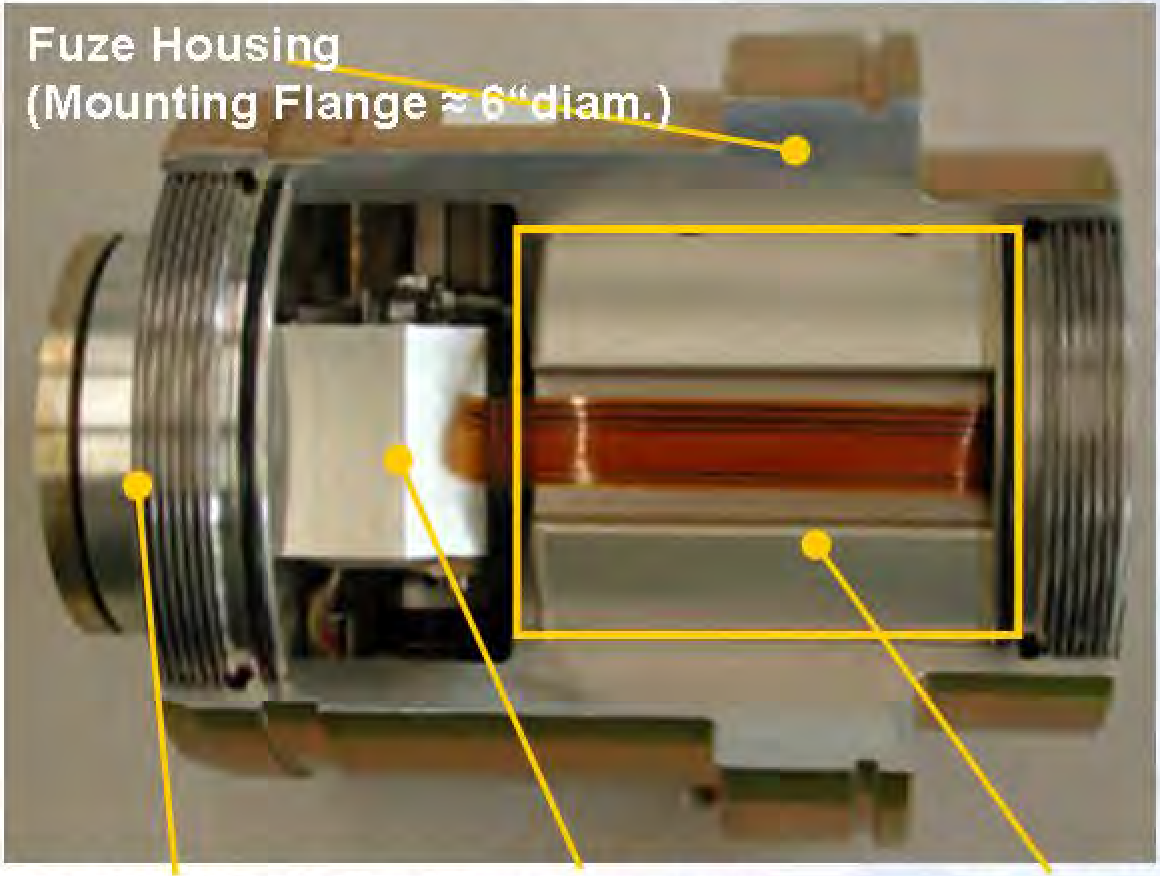
Key Capabilities of PIMPF

PIMPF =

- **active decision-making**, accelerometer-based fuze
- detects hard and soft layers within a structure ⇒ ***event detection*** and ***layer counting*** capability
- senses and counts ***voids***
- detonates the WH at a **desired burst point** inside buried or reinforced concrete targets
- adjustable **backup time delay**
- **programmable,** cock-pit selectable
- **out-of-line fuze** with an electro-mechanical SAD
- **Built-in-Test** capability
- **high reliability**

PIMPF - The Hardware

"PIMPF" as in production for the German Taurus S/OM



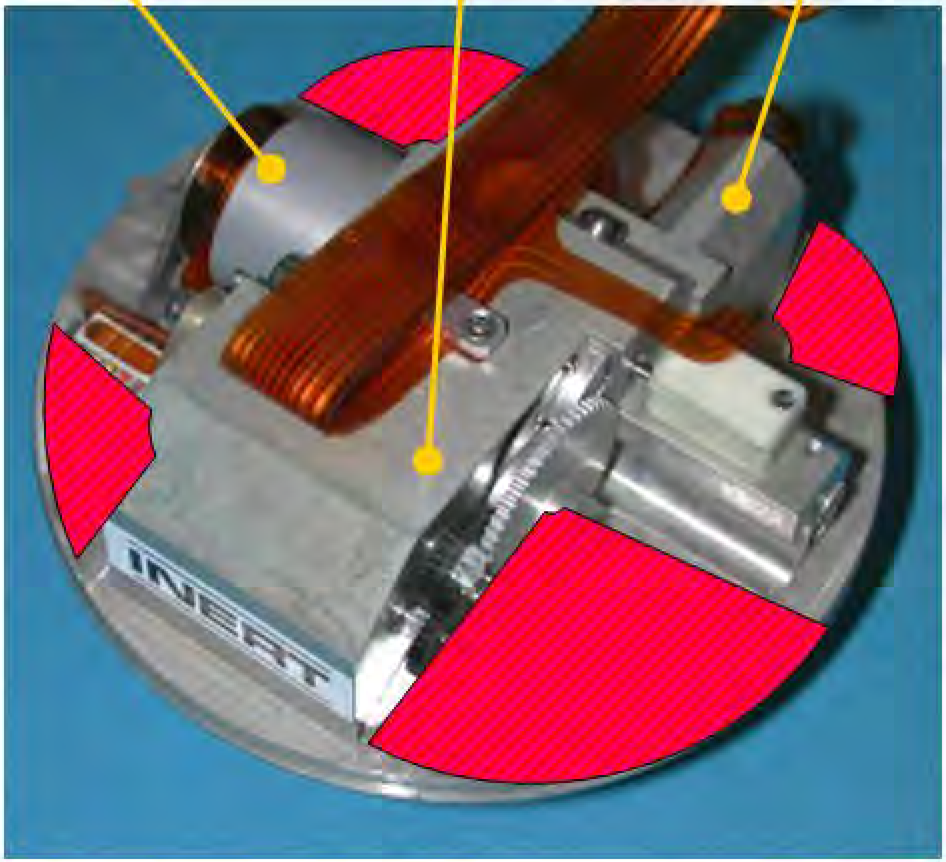
Booster Charge (HNS)

Electro-mechanical ***Safe & Arm Device (4.3")***

Fuze / Sensor Electronics: ***Target Detect. Dev. (2.5")***

PIMPF Safe & Arm Device (4.3 inch diam.)

Rotor incl. Detonator **Stepper motor** **Piston Actuator (PA)**



- Compliant to STANAG 4187 (equiv. MIL-STD 1316 D)
- 1st arming event by stepper motor turn (unlock PA)
- 2nd arming event by pyrotechnical actuator (1 W/1 A/5 min)
- Final arming event by stepper motor turn (detonator in line)
- metal layer detonator (100 mA No-Fire, shock-proof)
- 110 mm = 4.3" in diam., but there is room for a **low-risk** repackaging into a 3" standard fuze well

"US PIMPF" = BTF

The way forward – FCT of PIMPF *Rationale*

- The Department of Defense currently has **no void sensing smart fuze** suitable for its penetrating weapons systems.
- The cancellation of the USAF's Hard Target Smart Fuze (HTSF) Program has forced penetrating weapon developers to search for alternatives.
- This FCT will evaluate the Programmable Intelligent Multi-Purpose Fuze (**PIMPF**) alternative, a qualified fuze with the ability to detect and count voids in prosecuting hard, deeply buried targets, and **in production** for several NATO countries.
- In addition to e.g. the **CALCM** and **Tomahawk** requirements, also other penetrating weapon systems (fielded and/or in development) will require the capabilities of a PIMPF-type fuze to address emerging threats.
- If successful, this FCT will identify a smart fuze option for these weapon systems as well.
- While not quite a "one size fits all" solution, PIMPF would have many commonalities, retain some necessary differences, and complete an important development toward the needed fuze.

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The MEPHISTO Effector is in Series Production ...

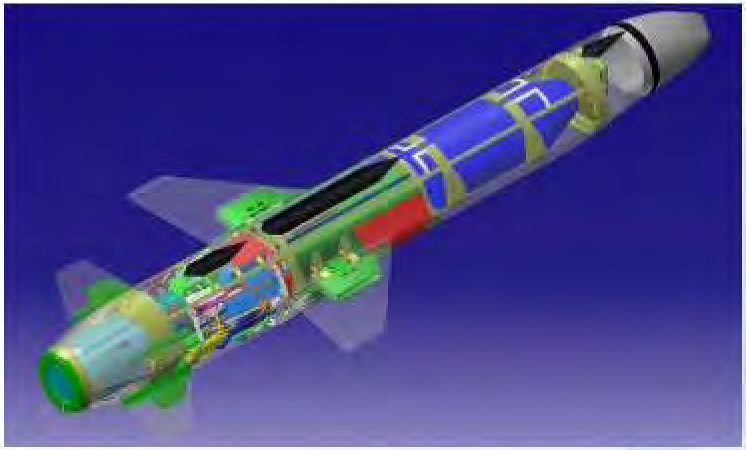
MEPHISTO Effector

for TAURUS KEPD 350

... for the NATO countries GERMANY and SPAIN

EADS DEFENCE & SECURITY

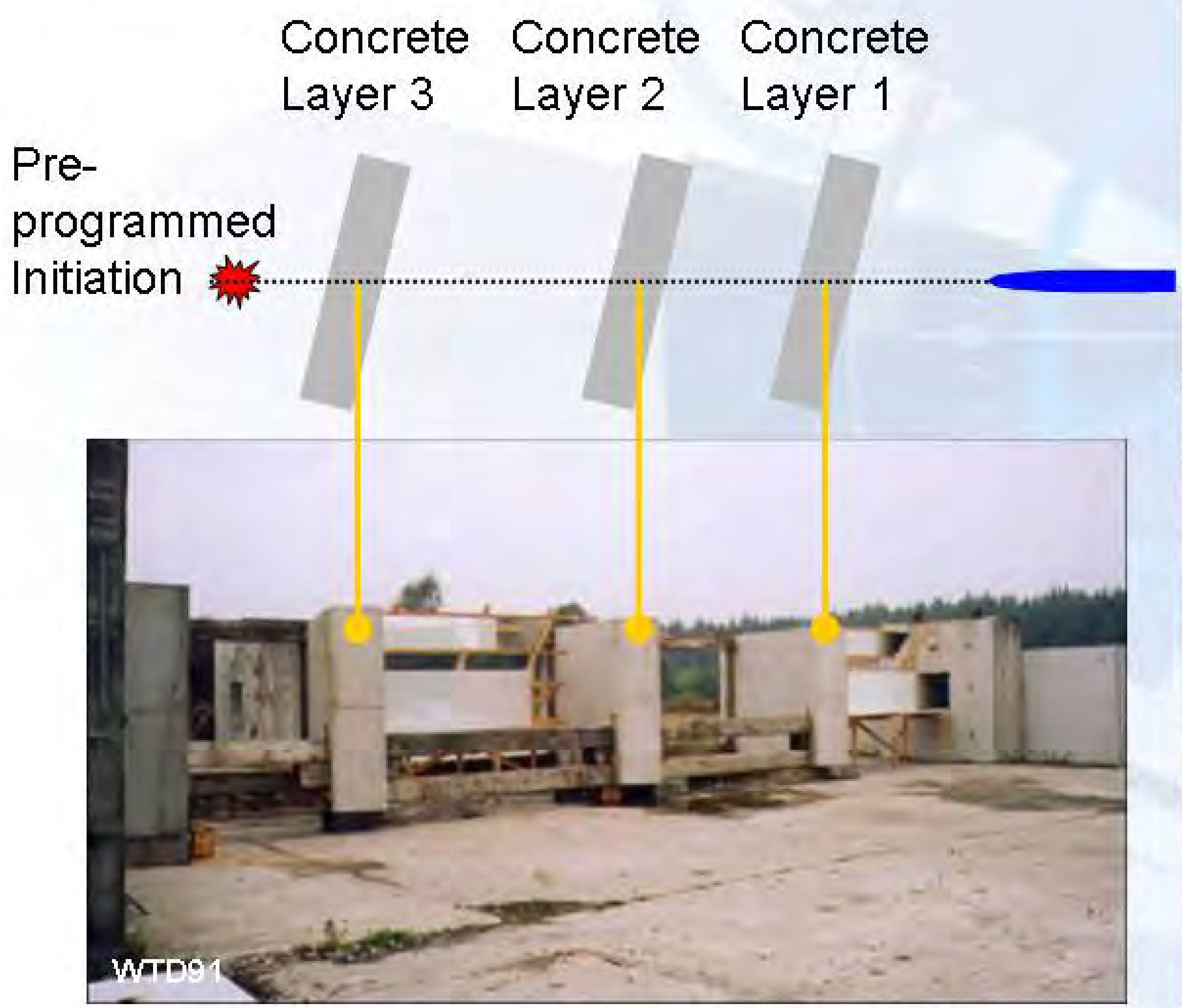
The NNW is qualified for the Series Production of the Norwegian Naval Strike Missile NSM

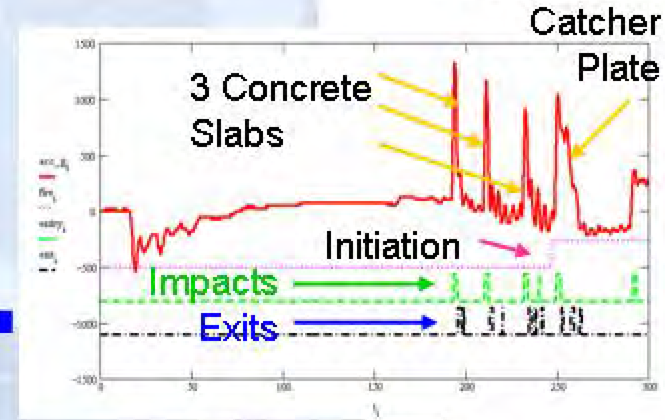


PIMPF is also qualified for Norway

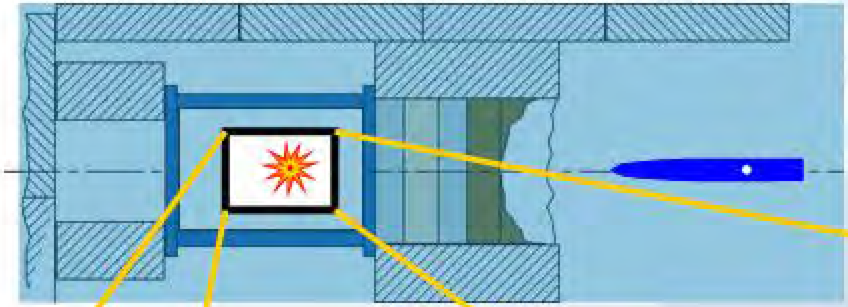
Cannon Testing & Sled Track Testing of MEPHISTO at WTD91, Meppen, Germany

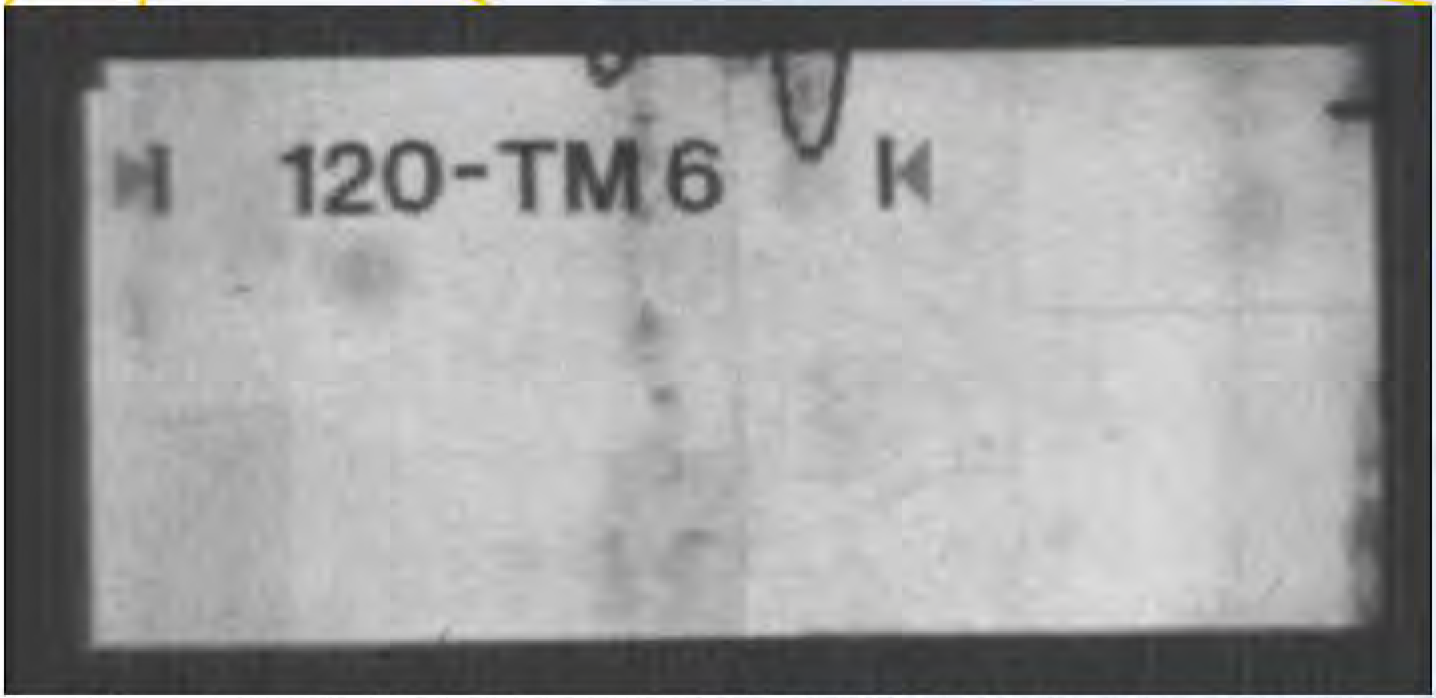
Cannon Testing - Target Set-up





Test Results, Cannon Tests with Flash Indicator Charge & Video





Flight Testing, Videos: Taurus FV1 and FOM

Flight Testing, Videos: Taurus FV1 and FOM

The End

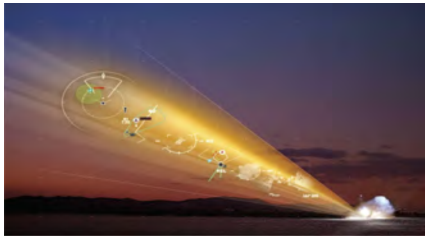
EADS / TDW wants to work U.S. and Coalition Forces Warfighters' priorities!

Thank you for granting this opportunity to help you get more from us.

Thank you for your attention!

Dr. Helmut Muthig
President & CEO
TDW Gesellschaft für verteidigungs-technische Wirksysteme mbH

Phone +49 8252 99 63 43
e-mail helmut.muthig@eads.com



PRECISION ENGAGEMENT

Overview

Precision Engagement Future Operations

An Industry Perspective

Challenges and Opportunities

Providing the Warfighter timely, effective and affordable Mission Solutions that span the breadth and depth of the Battlespace

Kevin Peppe
520.794.5919

Raytheon


Access

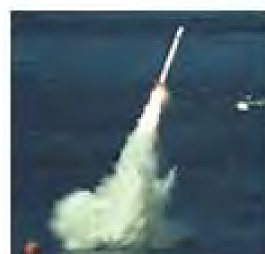

Locate


Identify


Track


Navigate


Communicate


Attack

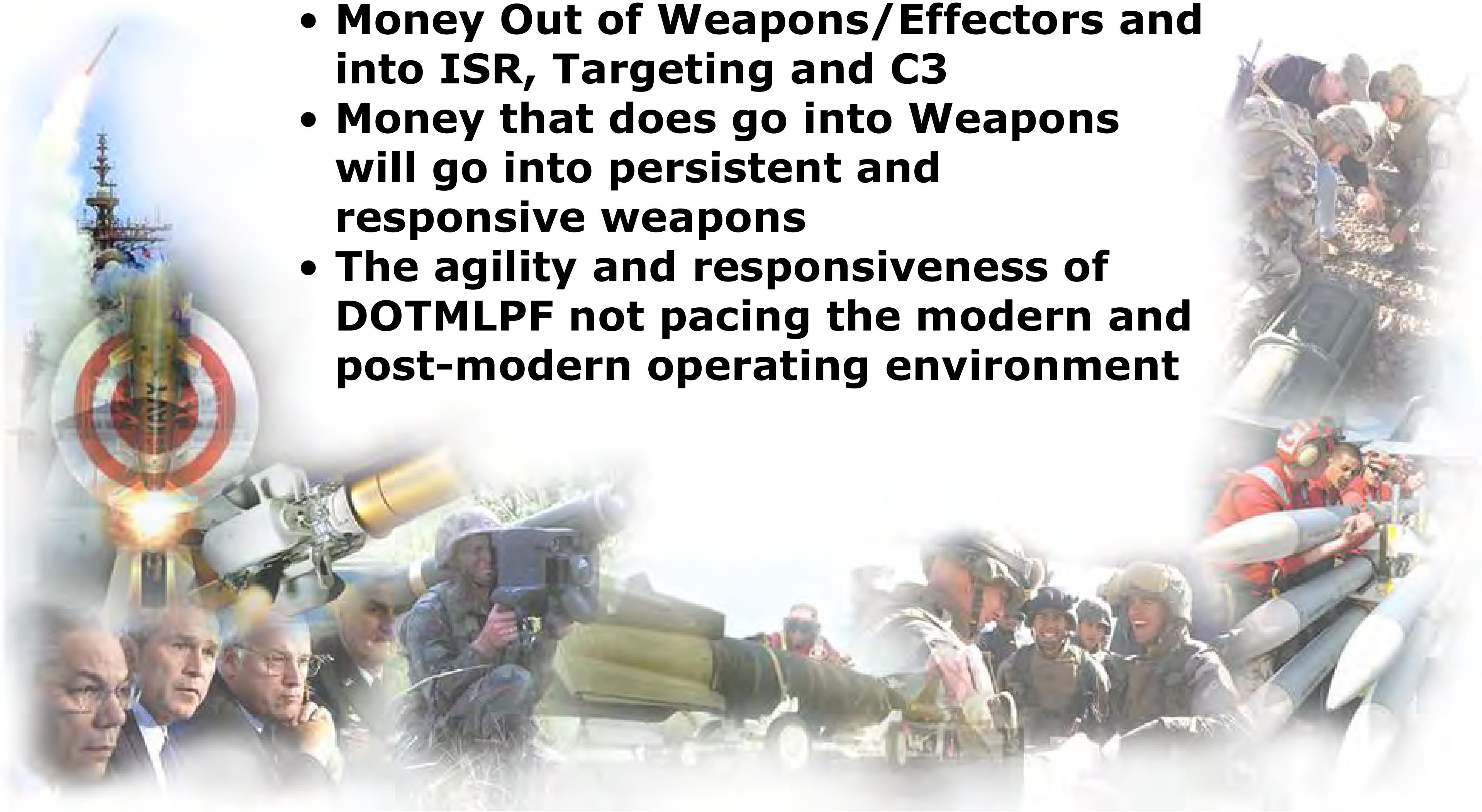

Assess

PSTS 2005

Outline and Overview: Three Macro-Trends

Raytheon
Customer Success Is Our Mission

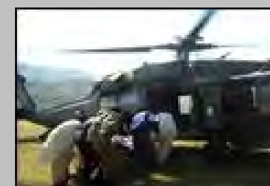
- Context and why it matters
  - A no-nonsense industry perspective
- Money Out of Weapons/Effectors and into ISR, Targeting and C3
- Money that does go into Weapons will go into persistent and responsive weapons
- The agility and responsiveness of DOTMLPF not pacing the modern and post-modern operating environment



Raytheon
Customer Success Is Our Mission

Context: Ways, Means & Ends

DEPARTMENT OF DEFENSE



Training **Readiness** **Weapons Stockpiles** **Operational Availability** **Qualified Personnel**

DEFENSE INDUSTRY

Certainty Valued Over "Irrational Exuberance"

Shareholder Value = (Growth x Margin x Cash Conversion)$^{\text{Goodwill}}$

PRECISION ENGAGEMENT STRATEGIC BUSINESS AREA

- **Focus on the Warfighter as Customer 1**
- **Turn 80% Mission Solutions fast**
- **Functionally span ISR, Targeting, C3 and Effects**

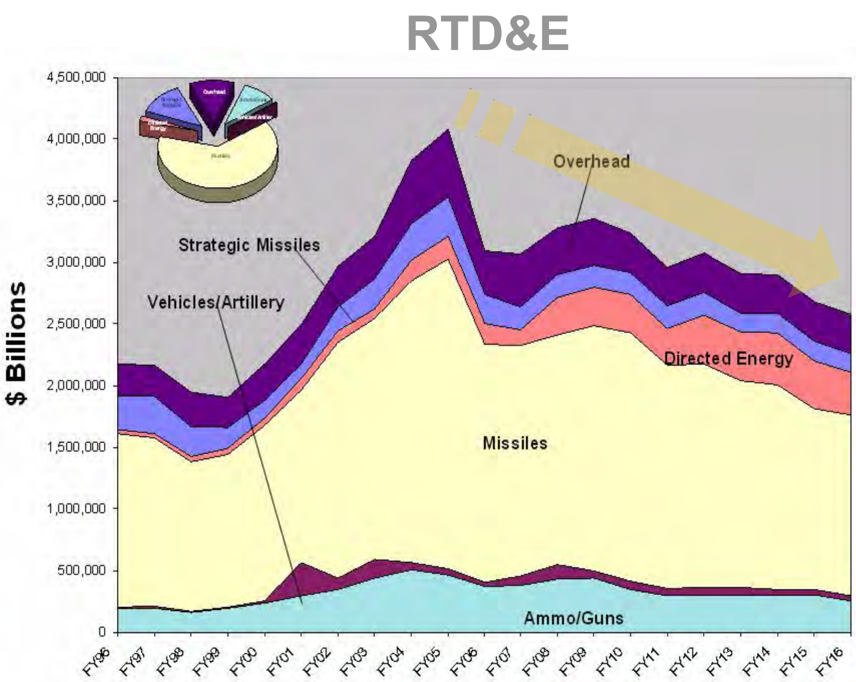
Ends: Ensure the strength & security of the United States through Global Stability

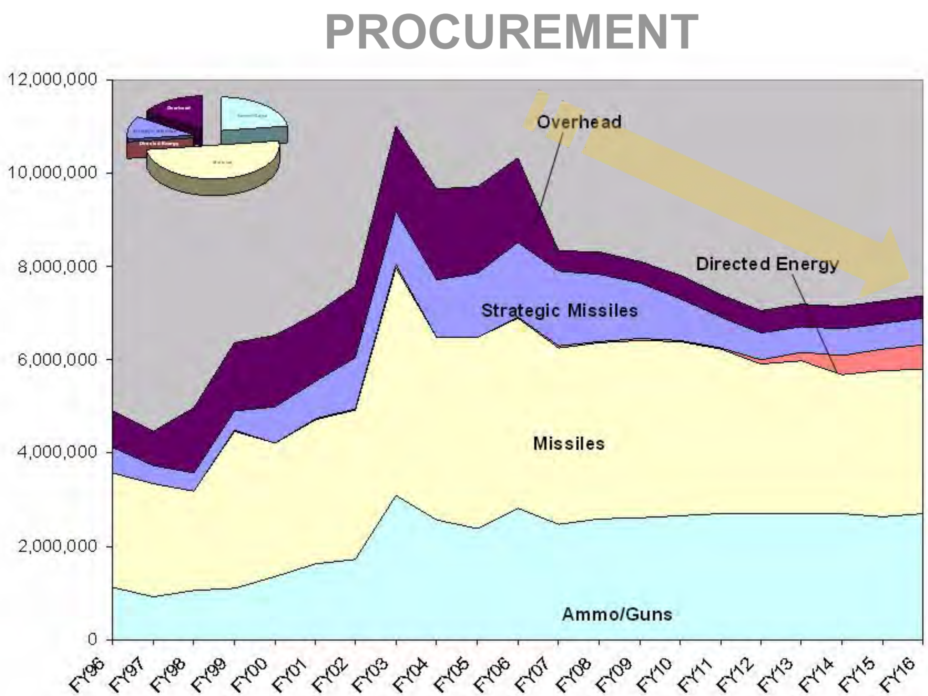
Goodwill

- Goodwill is defined as the value of the business in excess of its owner's equity
  - The value placed on intangibles assets, such as people, knowledge, relationships and intellectual property, is now a greater proportion of the total value of most businesses than is the value of tangible assets, such as machinery and equipment
  - The creation and management of intangible assets is often essential to long-term success
- Necessary but not sufficient components of Goodwill
  - Reliability
    - Predictability
    - Reputation
      - Ethics at the bottom line

Empirical Data: Less for Weapons, More for the Rest

Raytheon
Customer Success Is Our Mission



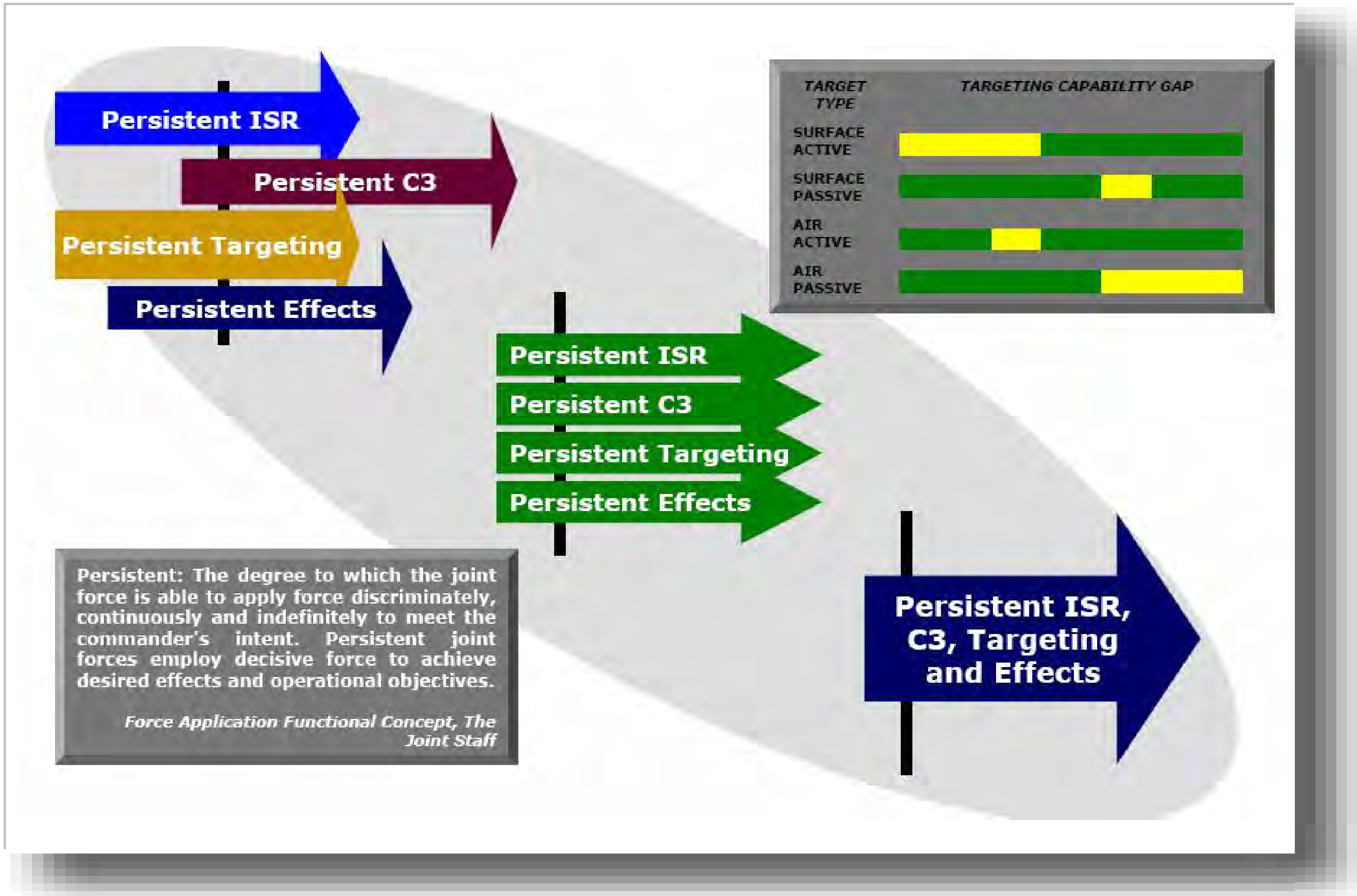


Growing Gap Between DOD TOA and DOD Weapons Acquisition and RDT&E

A Shift of DoD Resources From Effectors to ISR, Targeting & C3

Raytheon

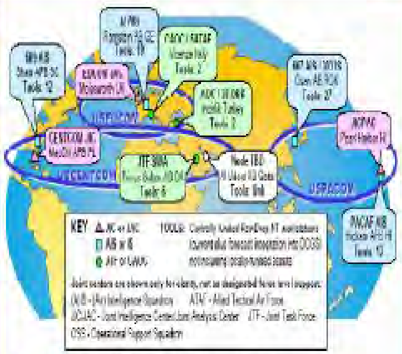
Customer Success Is Our Mission



Analysis, M&S Demonstrations and Real-World Ops Confirm

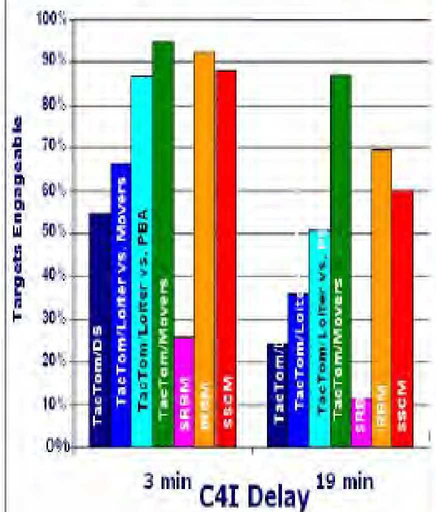
Raytheon
Customer Success Is Our Mission

ACC TARGET GENERATION ANALYSIS



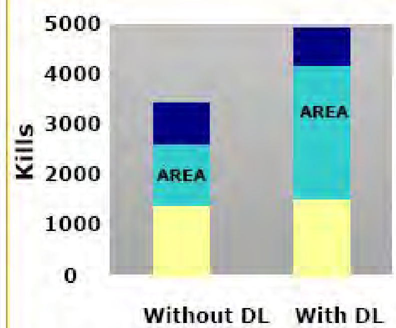
- BASED ON TWO MCO PLANS, ESTIMATED PEAK OF 3,000 GPS WEAPONS PER DAY USAGE (NOT INCLUDING SDB OR SMALL JDAM) (ACC/INX)
- MAXIMUM OF 1300 DMPIS PER DAY IN 2005 (BEST CASE)
- DEDICATED AIMPOINT MENSURATION RESOURCES (80) (1300 DMPIS PER DAY)

Northeast Asia Far Term



Speed of Command, Not Speed of Flight

120% LETHALITY IMPROVEMENT



- TARGETING AND NODE IN THE NET CAPABILITY KEY TO WARFIGHTING GAINS
- GETS AT MOVERS
- OPENS KILL BOX IN BOTH OVER TIME AND SPACE
- LINK REQUIRES LESS THAN 8 IN³
- UNIT COST UNDER $5K

Theoretical Data Supports an Accelerating Trend

Significant Per-Round Lethality Improvements

Raytheon
Customer Success Is Our Mission

- Generate targets in theater and in volume
- Process and distribute those targets fast and forward
- Act on those targets with immediacy

Persistent ISR, C3, Targeting and Effects

SENSORS AND WEAPONS THAT ARE TRULY 'Nodes-in-the-Network'

Bottom Line: Spend 'The Next Dollar' on ISR&T, C3 & Weapons Mods to Exploit

Growth Through ISR, C3 and Targeting: Implications for Industry

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- Position based solely on weapons portfolio increasingly risky
- Even an enterprise focus might risk not bringing 'Best-of-Breed-Across-the-Effects-Chain' to the Warfighter
- As most significant M&A opportunities already realized, might be entering an era of global partnerships
- Cost per round must decrease (or at least level off) to reflect investment in networks

Follow the Money

Move to Responsive PE Mission Solutions

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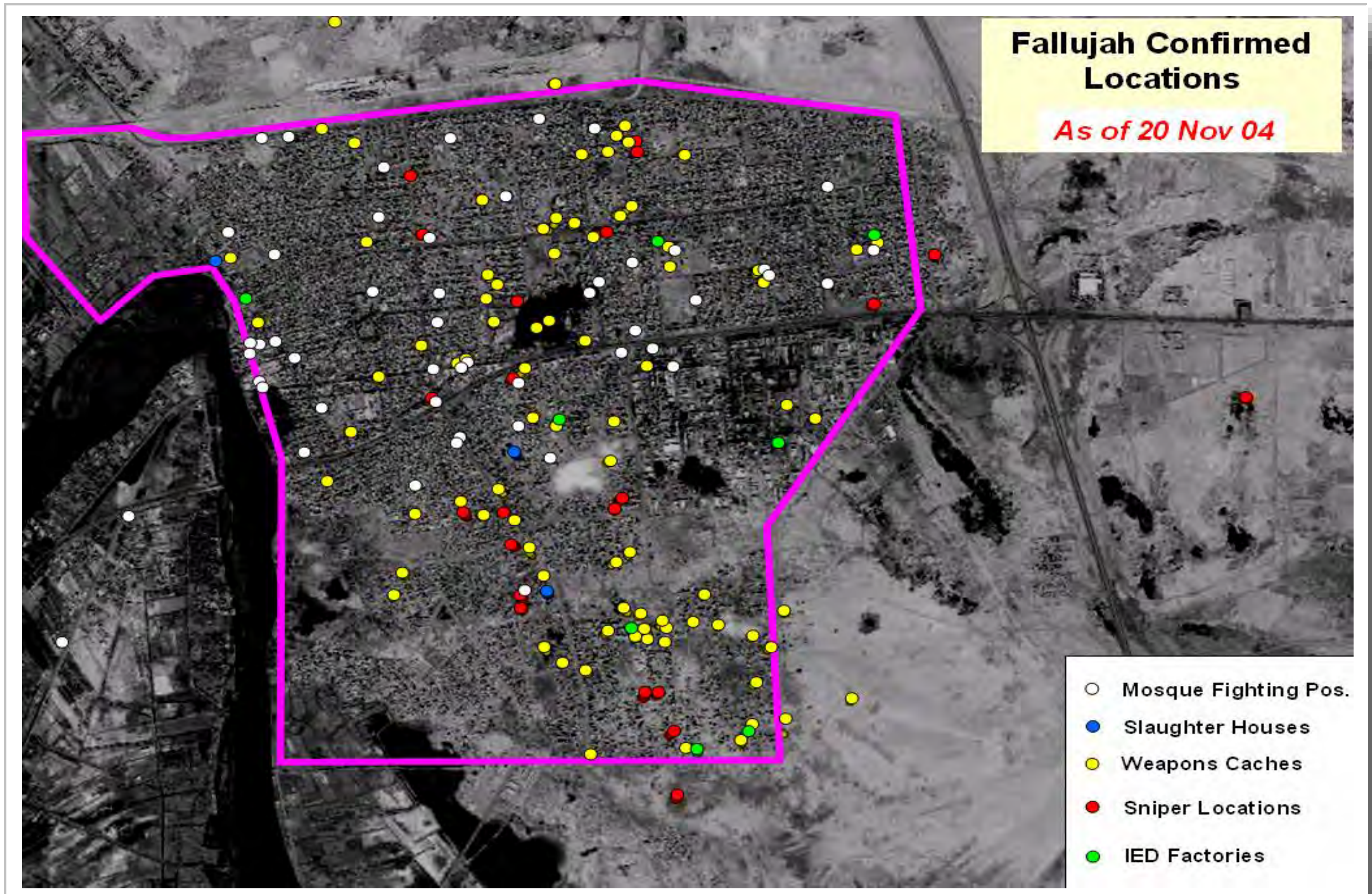
Warfighter Capability Gap

"Precision cannon artillery delivered munitions to attack hostile forces in urban areas/complex terrain while minimizing collateral damage."

The Battlespace



Non-linear, Non-contiguous Challenge

Fire Support Opportunity: Alternatives Examined

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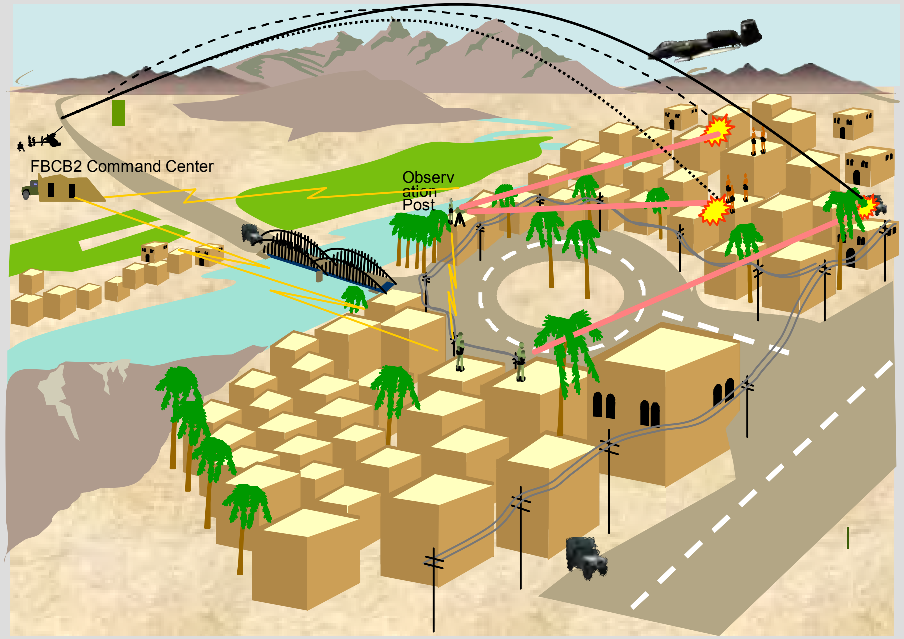
IN IRAQ TODAY

1. A/C precision fires for the majority of operations
2. Weather and A/C availability control Time-to-Kill
3. Extended execution timelines from sensor to shooter – between 20 to 30 minutes.
4. No persistent and precise indirect fires capability.

PRECISION ENGAGEMENT MISSION SOLUTION 2005



1. Long range precision fires in adequate volumes to support real-world USMC operations.
2. Target coordinates transferred by machine to machine interface within seconds.
3. Execution timelines from sensor to shooter greatly compressed.
4. Connected to AFATDS fires network.

Results Summarized

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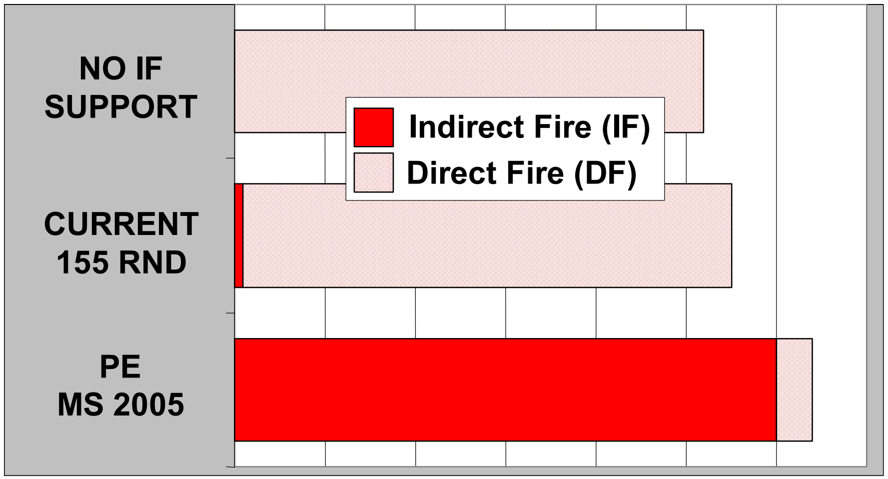
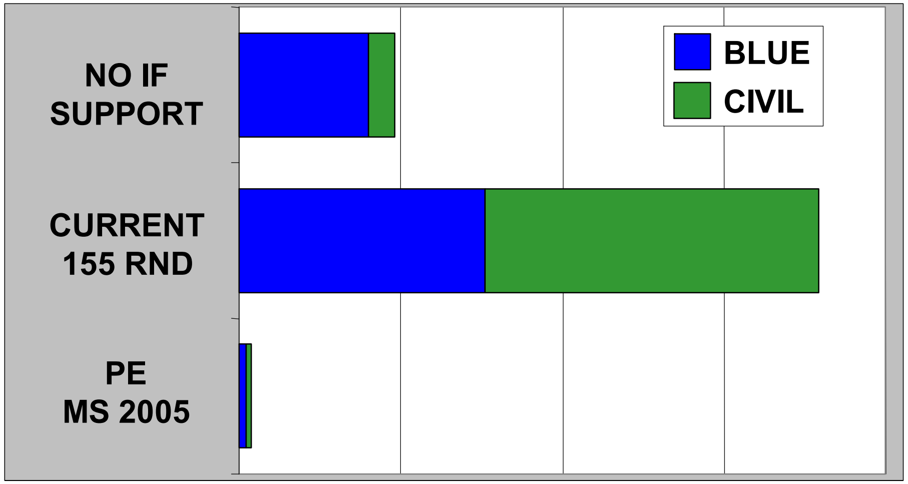
MOE I: MAXIMIZE IF THREAT KILLS

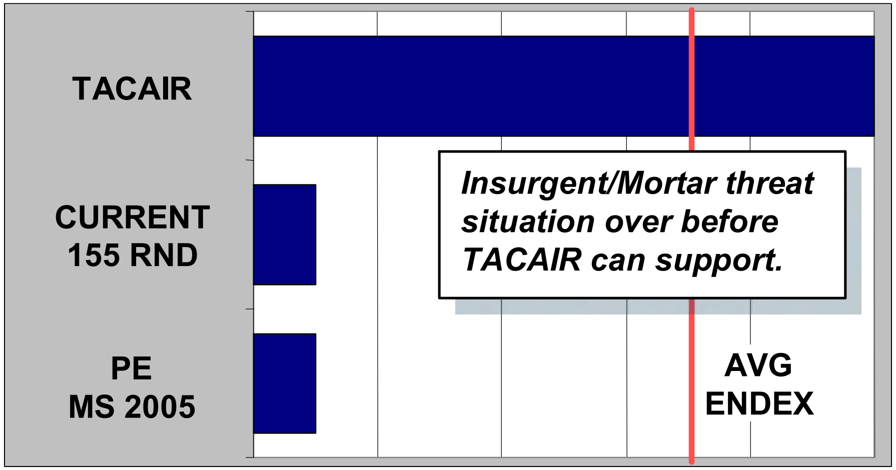


MOE II: MINIMIZE LOSSES



MOE III: MINIMIZE COLLATERAL DAMAGE

MOE IV: MINIMIZE RESPONSE TIME

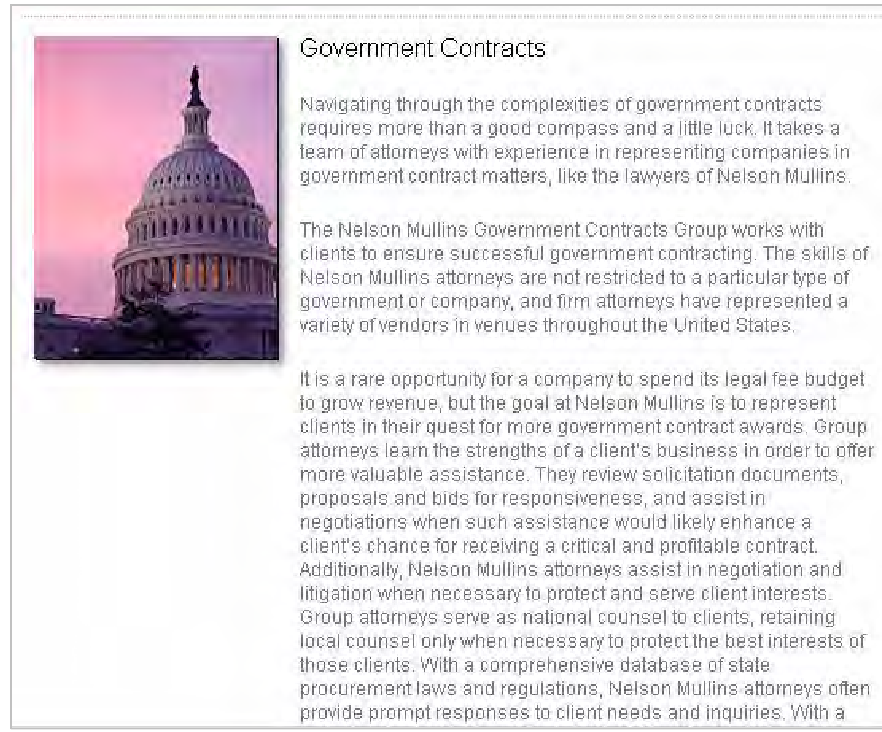


Responsiveness Through Enhanced Persistence: Implications for Industry

- Precision
  - Decreasing Opportunities
- Measured
  - Smart fusing and in-flight re-programming
- Persistence through loiter
  - Pace advances in ISR, Targeting and C3
  - Significant third-party issues
  - Significant technical challenges
- Persistence through being there
  - Land-based focus
  - Re-think effective and affordable volume fires

Challenges are Evolving: Requires a Going Forward Perspective

DOTMLPF: Unsynchronized Transformation



Government Contracts

Navigating through the complexities of government contracts requires more than a good compass and a little luck. It takes a team of attorneys with experience in representing companies in government contract matters, like the lawyers of Nelson Mullins.

The Nelson Mullins Government Contracts Group works with clients to ensure successful government contracting. The skills of Nelson Mullins attorneys are not restricted to a particular type of government or company, and firm attorneys have represented a variety of vendors in venues throughout the United States.

It is a rare opportunity for a company to spend its legal fee budget to grow revenue, but the goal at Nelson Mullins is to represent clients in their quest for more government contract awards. Group attorneys learn the strengths of a client's business in order to offer more valuable assistance. They review solicitation documents, proposals and bids for responsiveness, and assist in negotiations when such assistance would likely enhance a client's chance for receiving a critical and profitable contract. Additionally, Nelson Mullins attorneys assist in negotiation and litigation when necessary to protect and serve client interests. Group attorneys serve as national counsel to clients, retaining local counsel only when necessary to protect the best interests of those clients. With a comprehensive database of state procurement laws and regulations, Nelson Mullins attorneys often provide prompt responses to client needs and inquiries. With a

The Trailing Edge of Transformation

Doctrine, Organization, Training, Materiel, Leadership And Education, Personnel And Facilities

Unsynchronized Transformation: Implications for Industry

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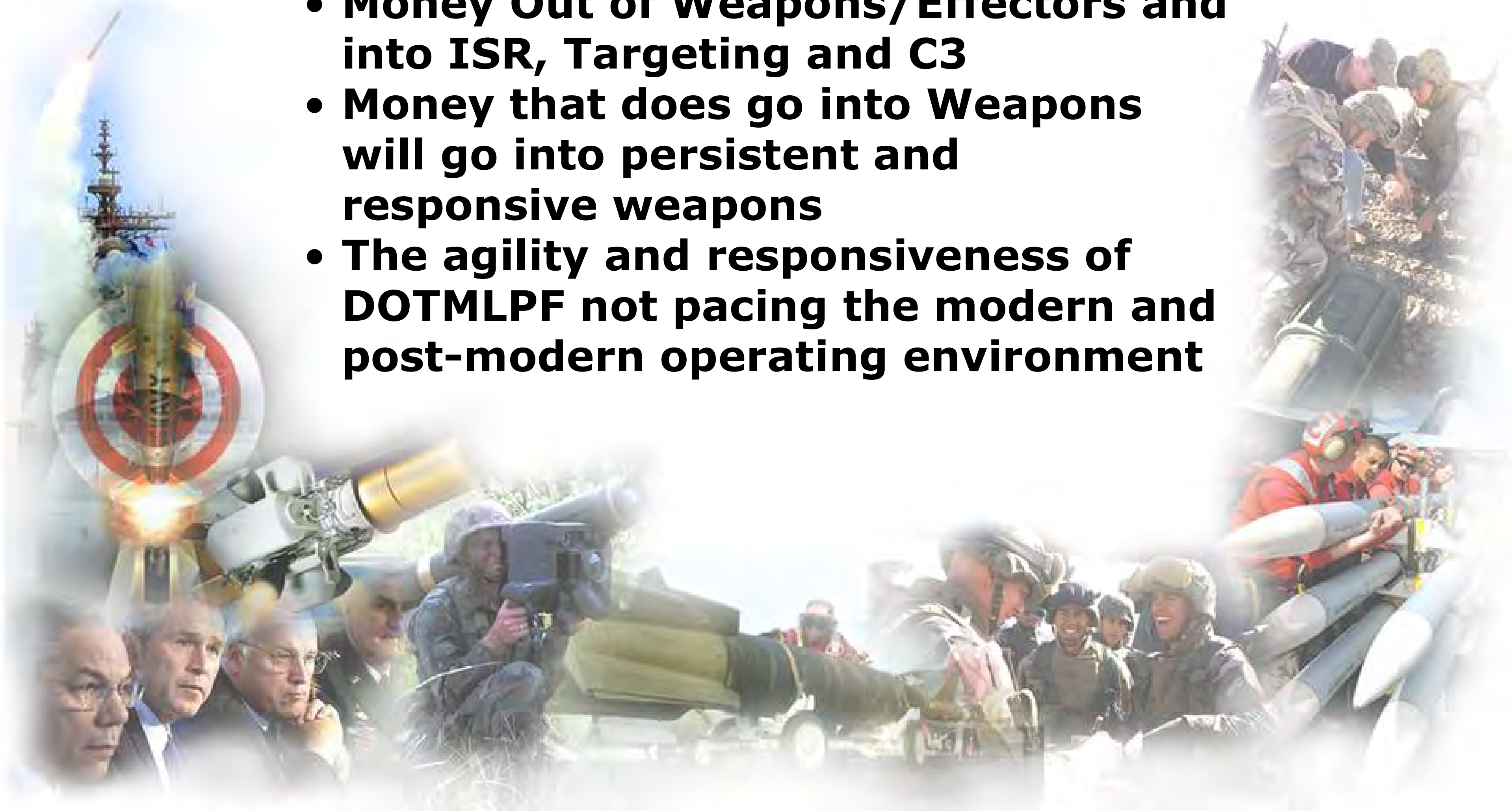
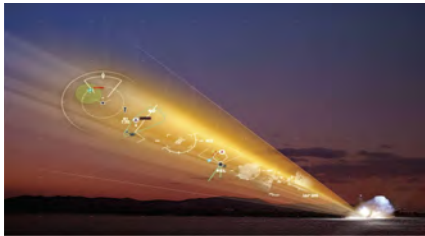
- Opportunities
  - Performance Based Logistics (+)
  - Fee for Service
- Challenges
  - Services & Contractor: Seam between required competencies
  - Fee for Service Value Stream

Operators & Industry Partners May Have to 'Lead-Turn' The Money

Summary

- **Context and why it matters**
  - **A no-nonsense industry perspective**
- **Money Out of Weapons/Effectors and into ISR, Targeting and C3**
- **Money that does go into Weapons will go into persistent and responsive weapons**
- **The agility and responsiveness of DOTMLPF not pacing the modern and post-modern operating environment**





PRECISION ENGAGEMENT

Raytheon

Overview

Precision Engagement Future Operations

An Industry Perspective

Challenges and Opportunities

Providing the Warfighter timely, effective and affordable Mission Solutions that span the breadth and depth of the Battlespace

Kevin Peppe
520.794.5919

Access

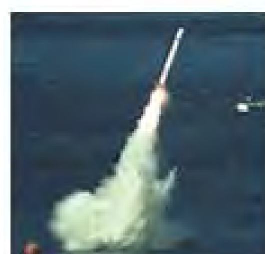
Locate

Identify

Track

Navigate

Communicate



Attack

Assess

PSTS 2005

Department of Defense
High Speed / Hypersonic S&T
&
Networked Weapons

Dr. Michael S. Richman
Associate Director, Aerospace Technology
Office of the Deputy Under Secretary of Defense (S&T)

Outline

- DDR&E Transformation Initiatives
- NAI – High Speed / Hypersonic S&T plan
- Networked Weapons

Technology and Transformation

Transformational Attributes

Knowledge

Agility

Speed

Lethality

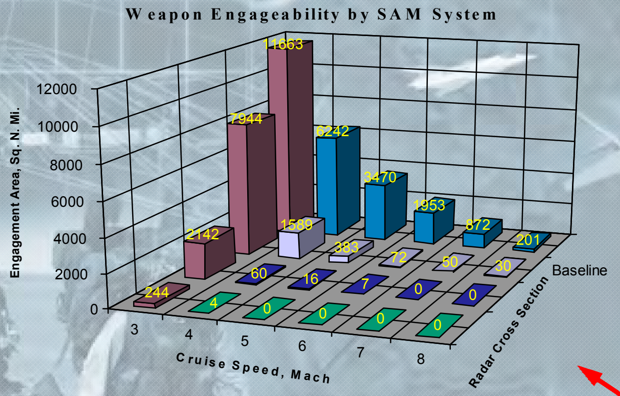
- **DDR&E Transformation Technology Initiatives**
  - National Aerospace Initiative
  - Energy and Power Technologies
  - Surveillance and Knowledge Systems

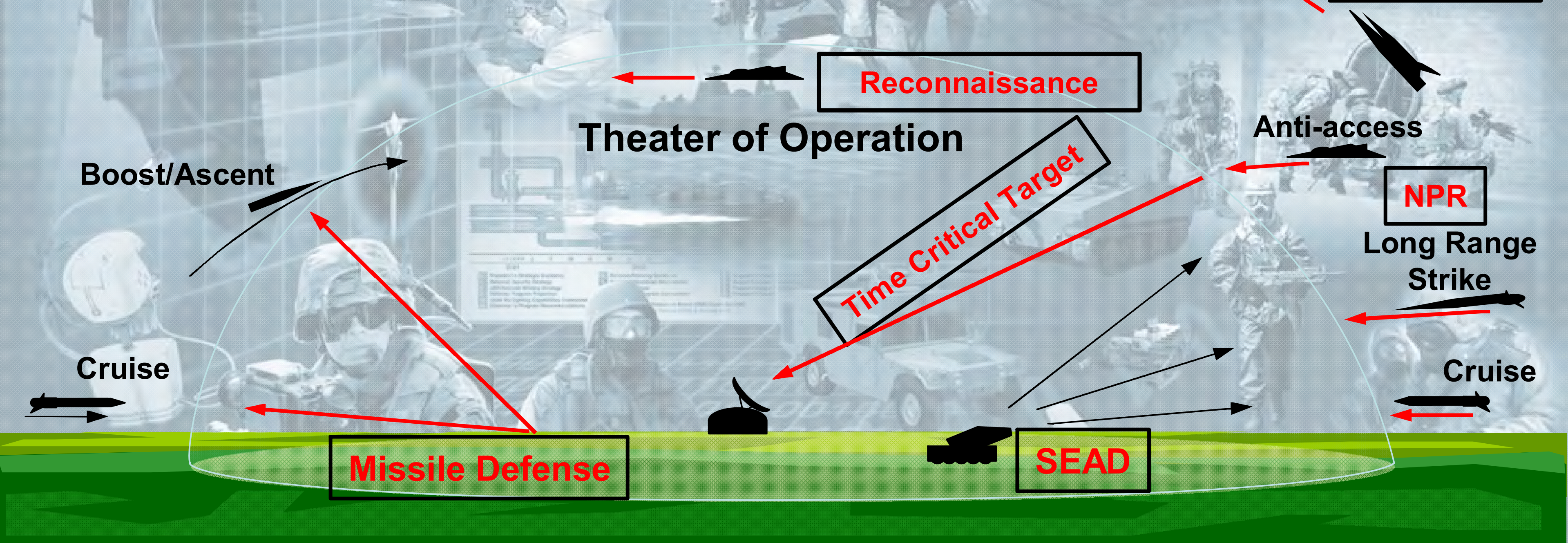
Value of Speed… global strike

Benefits

- Reduced Adversary Detection and Reaction Time
- Reduced Strike Package Assets
- Increased Engagement Area by a Single Platform
- Increased Shooter Survivability
- Increased Kills per Launch
- Address the Deep Penetration Problem

1.8m (speed) ~ Survivability/Vulnerability ~ 1/10 (Signature)

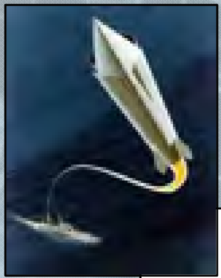




Notional System Attributes

- Speed (Average Velocity) = Mission Range / Mission Time
  - Application – Time Critical Strike
  - Application – Hard and Deeply Buried Targets
  - Application – Prompt Global Strike
- Survivability = 1/Vulnerable Time, which is the amount of time that the vehicle is susceptible to detection and intercept
  - Application – Speed option to access capability
- Payload Capacity = Payload Mass Fraction x Takeoff Gross Weight
  - Application – Space Access
  - Application – Long-range Strike

Notional System Attributes





BASELINE

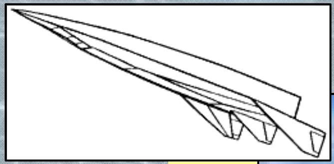
B-2, B-777,SR-71, D-21, SLAM-ER, JASSM, ASALM, STS

Phase I – 2010

Expendable Systems
- Mach 4-6+ Cruise
- Range up to 1000 nmi
- 15% Payload Mass Fraction

Reusable Systems
- Mach 5-7 Flight

Near Term



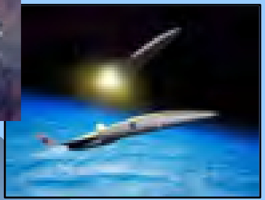

Phase II – 2015

Expendable Systems
- Mach 6-8 Cruise
- Range up to 2000 nmi
- 30% Payload Mass Fraction

Reusable Aircraft Systems
- 5000 miles in < 2 hrs
- 3x Improved Survivability

Reusable HTHL TSTO
- 3% Payload Fraction
- One failure in 500 flights
- $5,000 per pound to LEO

Mid Term

Phase III – 2020

Expendable Systems
- Mach 12+ Interceptor

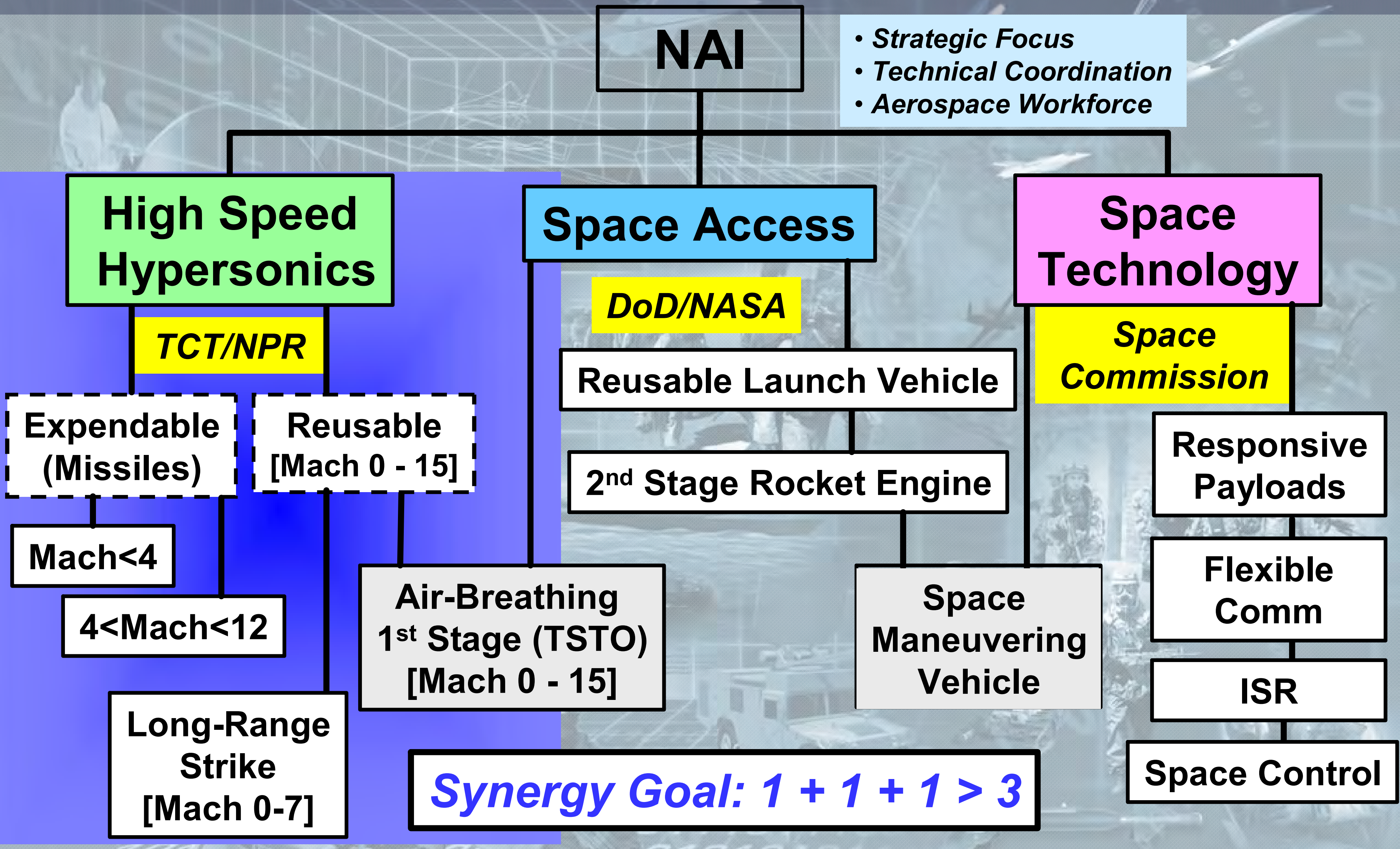
Reusable Aircraft Systems
- Anywhere in < 2 hrs
- 6x Improved Survivability

Reusable HTHL TSTO
- 5% Payload Fraction
- One failure in 5,000 flights
- $1,000 per pound to LEO

10x Increased Average Velocity
6x Increased Aircraft Survivability
5x Increased Payload Capacity

Far Term

NAI Technology Framework



High Speed/Hypersonics Taxonomy

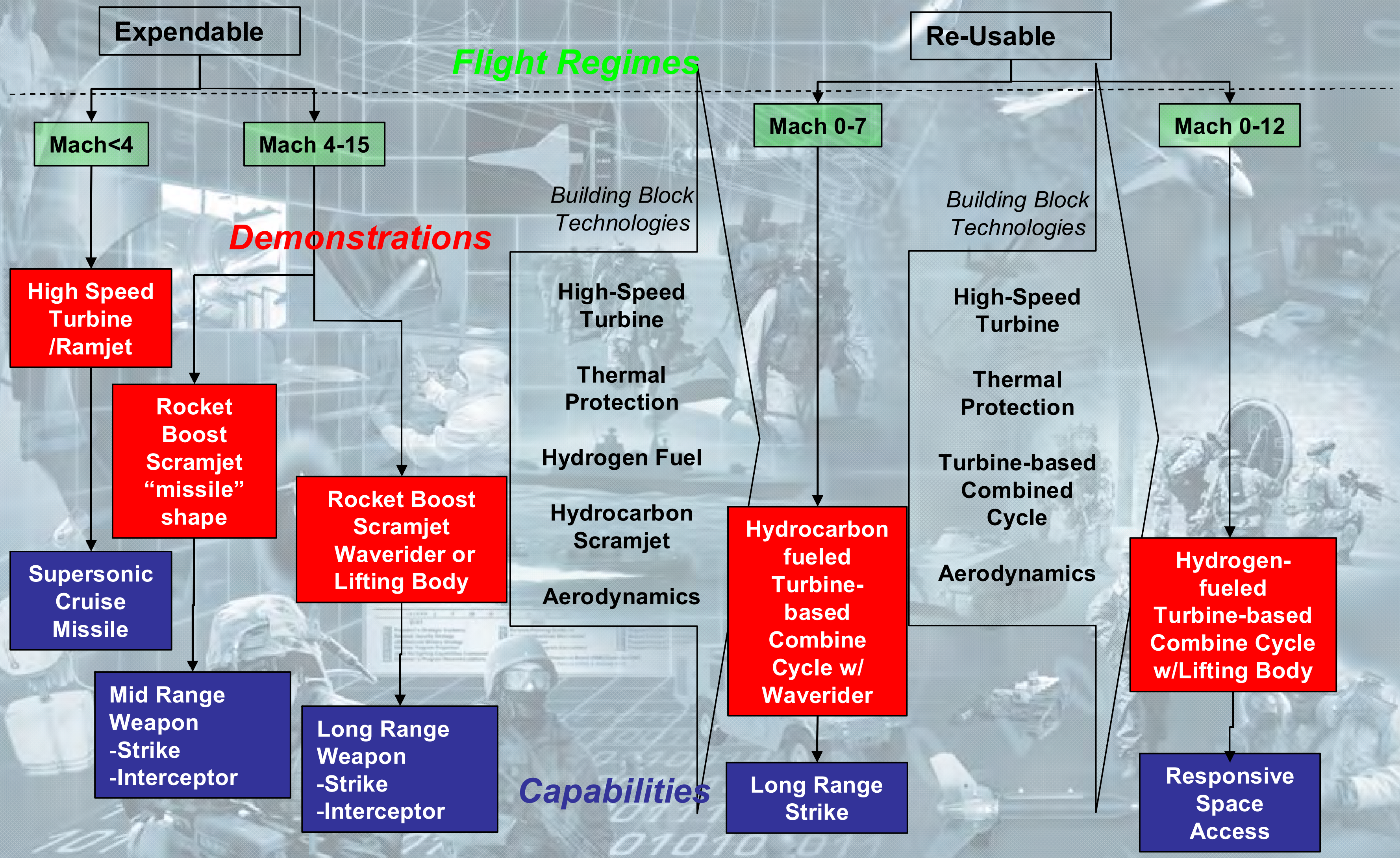
Capabilities Supported

- On-demand Spacelift
- Assured Access Spacelift
- Long Range Strike
- Global Precision Engagement
- Air & Missile Defense

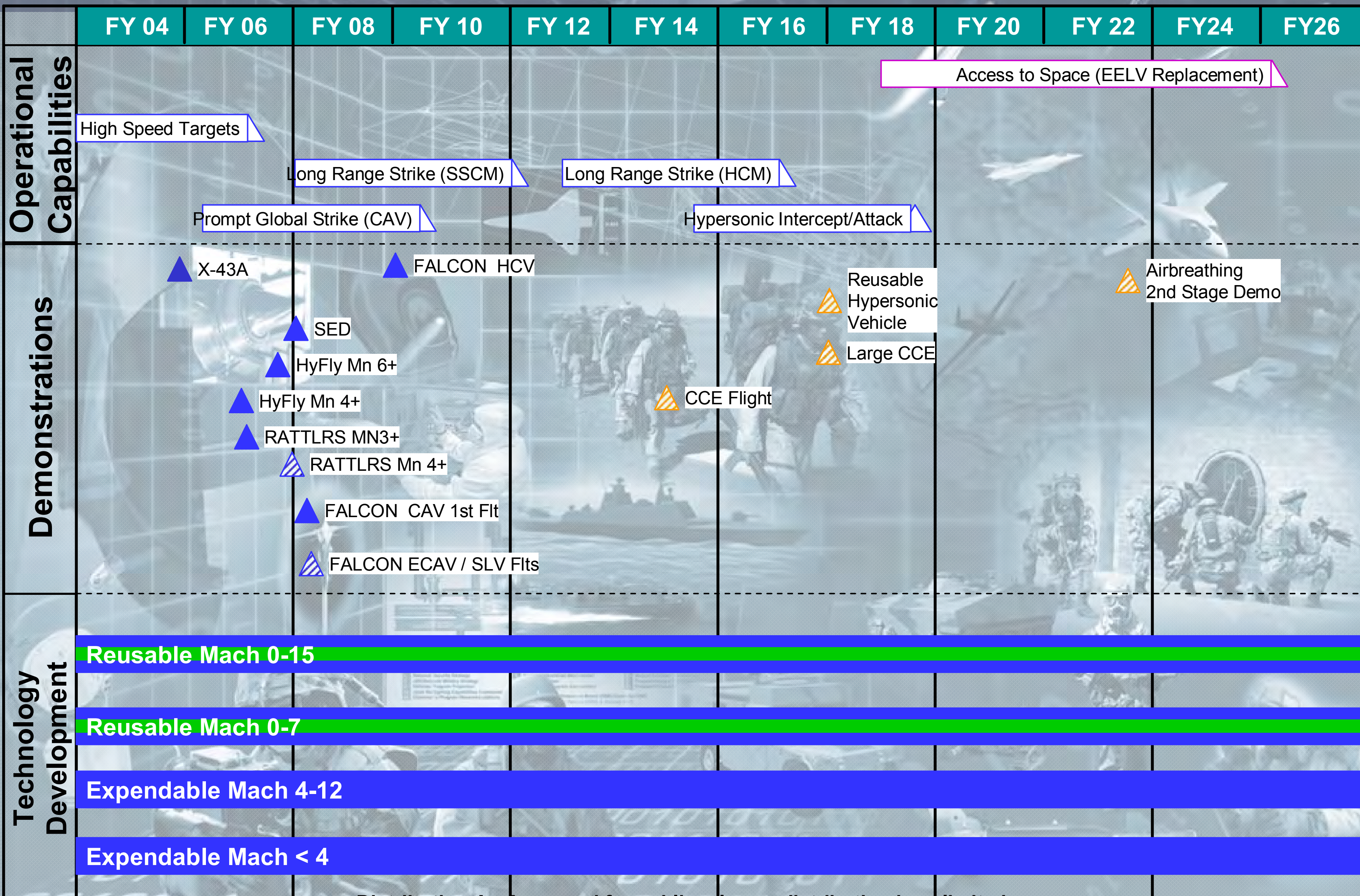
System	Subsystem	Research Area
Airframe	Configuration	Propulsion/Airframe Integration Design Tools Shock Interaction Airframe Thermal Loads
	Subsystems	SOA
	Stability & Control	Propulsion/Airframe Integration Design Tools Guidance, Navigation & Control
	Thermal Management & Structures	Design Tools Shock Interaction Airframe Thermal Loads
	Propellant Systems	Fuel Control System Airframe Thermal Loads
Propulsion	Air Induction	Engine Performance Propulsion/Airframe Integration Design Tools Shock Interaction
	Compression	Engine Materials Thermal Balance Design Tools
	Combustion	Endothermic Fuel Coking Design Tools Fuel Control System
	Turbines	Endothermic Fuel Coking
	Exhaust	Propulsion/Airframe Integration Engine Performance Design Tools
	Propellants	Endothermic Fuel Coking Fuel Control System
	Structures & Materials	Engine Thermal Loads Engine Materials Thermal Balance
	Cycle Integration	Thermal Balance Engine Performance Design Tools
	Control Systems	Fuel Control System
	Mechanical Systems	Engine Materials Thermal Balance
	Boosters	SOA

Note: Reusable airframe technologies addressed via Space Access pillar

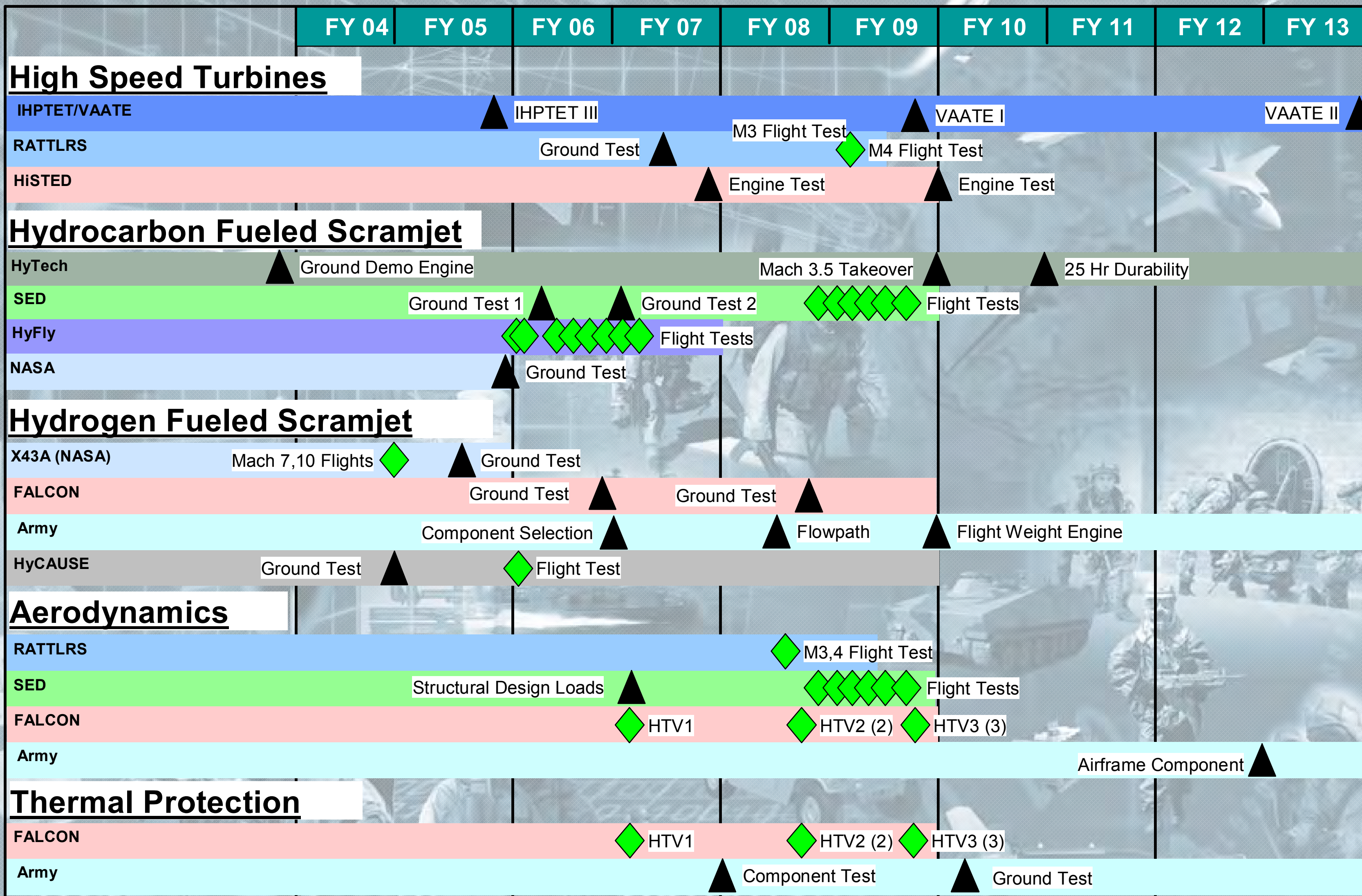
Technology Critical Path



High Speed/Hypersonics Level I Roadmap

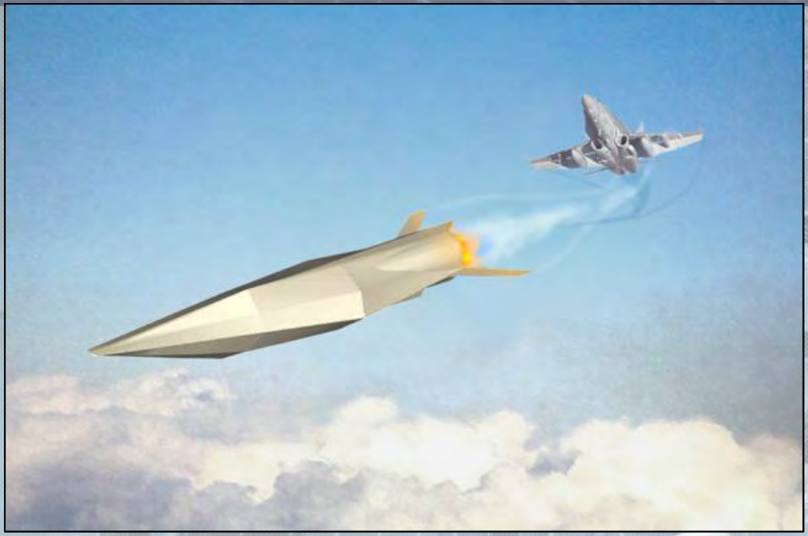


High Speed / Hypersonic S&T



RATTLRS Flight Demonstration

(**R**evolutionary **A**pproach **T**o **T**ime-Critical **L**ong-**R**ange **S**trike)



PAYOFFS:

- **Ability to Engage Time-Critical Targets**
- **High Efficiency Engine Enables Extended Ranges**
- **Potential High-Speed and Loiter Capabilities**
- **Flexible, Multi-Mission Weapons**
- **Multiple Launch Platform Compatible**
- **Steppingstone to Space Access, NAI**

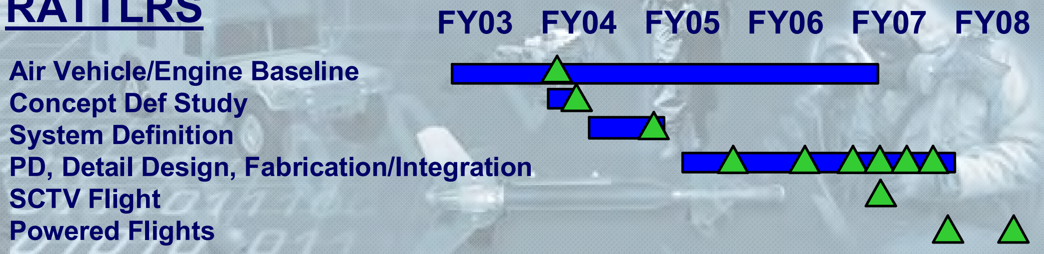
READINESS (TRL 4-6):

- **Mach 3+ Expendable Turbine (TRL 4 to 6)**
- **High L/D Configurations (TRL 5 to 6)**
- **Aeropropulsion Integration Methodology (TRL 5)**
- **High Temperature Airframe Mat'l (TRL5 to 6)**

OBJECTIVES:

- Flight Demonstrate a Supersonic Expendable Turbine-Powered Flight Vehicle Demonstrating Integrated Inlet/Nozzle/Airframe/Engine System Technologies Which is Traceable To A Tactical Weapon System
- **Minimum Objectives :**
  - Two Mach 3 Flight Demonstrations 2008
  - Traceability to a Weapon System
  - Mach 3.0+ Cruise
  - Acceleration: 0.25 g or greater
  - Cruise Time: 5-minutes or greater
- **Growth Objectives :**
  - One Mach 3 Flight Demonstration 2008
  - Two Mach 4 Flight Demonstrations 2010
  - Mach 4 Cruise
  - Acceleration > 0.5 g
  - Cruise Time > 15-minutes
  - Traceability to a Weapon System
  - Optimized Vehicle Configuration
  - Flexible Flyout in Multiple Speed Regimes

RATTLRS



Air Force/DARPA Scramjet Engine Demo (SED) Program

<u>Objective</u>: Demonstrate viability of the endothermic hydrocarbon-fueled scramjet engine developed under the USAF Hypersonic Technology (HyTech) program.

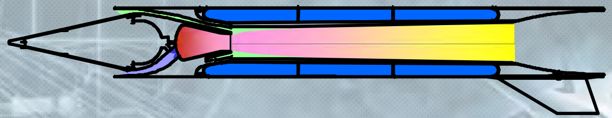
<u>SED Will</u>:

- Collect ground & in-flight test data of an operating hydrocarbon fueled scramjet engine
  - Actively fuel-cooled engine controlled using a closed loop, digital, fuel distribution system.
  - Uses airframe and subsystem technologies developed under the DARPA Affordable Rapid Response Missile Demonstrator (ARRMD) program.
- Validate design methodologies and tools (including computational and ground test techniques)
- Complete a flight test series
  - Operate scramjet from 4.5 M to 6.0-7.0+ M
  - 4-8 flights, starting in FY09

DARPA/ONR Hypersonic Flight Demonstration (HyFly) Program

Approach

Rocket Boosted Axisymmetric Vehicle
- Dual Combuster Hybrid Ramjet
- Liquid Hydrocarbon Fueled

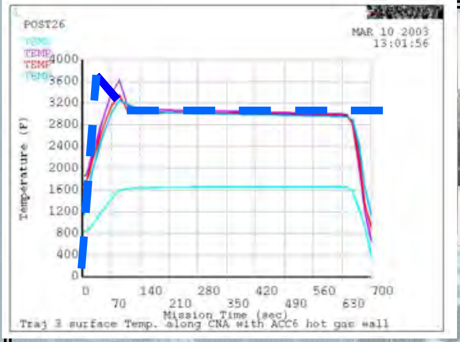


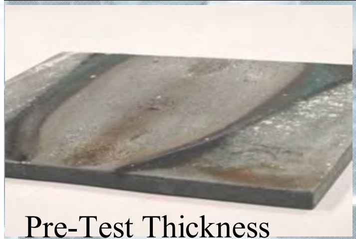
Uncooled Structures
- Ceramic Matrix Based Engine, Nose & Leading Edges
- Cast Titanium Airframe

Program Objectives

Tactical Sized Powered hypersonic Missile flight
- **6 Powered Flights**
- **Mach 6 sustained cruise, Fly 400 nmi**
- **Submunition dispense demonstration**

Recent Progress

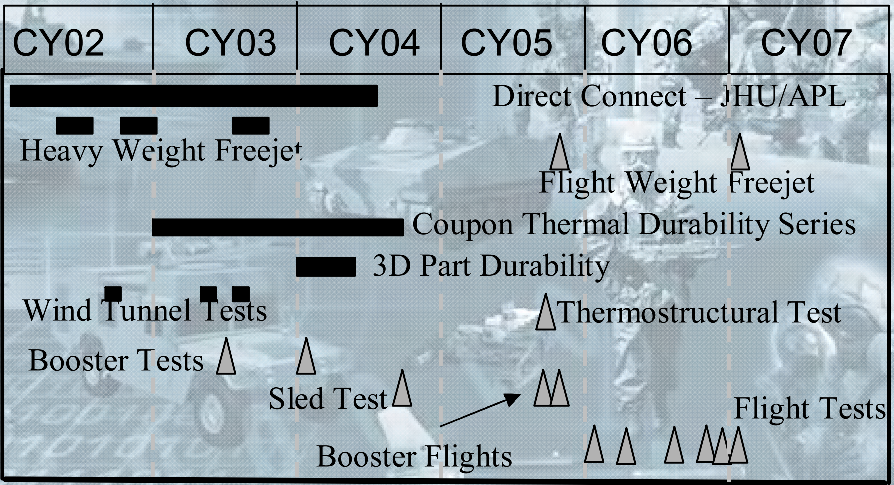




Pre-Test Thickness
Range 0.183 - 0.188”
Post-Test Thickness
Range 0.179 - 0.181”

Material coupons tested to 4200°F near zero erosion
CMC Engine Component pathfinder prototypes complete
Mach 6.5 Engine Operability Demonstrated
Booster-Sustain Vehicle Separation Demonstrated

Milestones



National Aerospace Initiative
High Speed / Hypersonics S&T

High Speed / Hypersonics On-Track

Expendable

- Navy/DARPA HyFly Program [Mach 6 Dual Combustion Ramjet]
- AFRL/DARPA Single Engine Demonstrator [Mach 8 Scramjet]
- Navy RATTLRS Cruise Missile Demo [Mach 3+ Turbine]

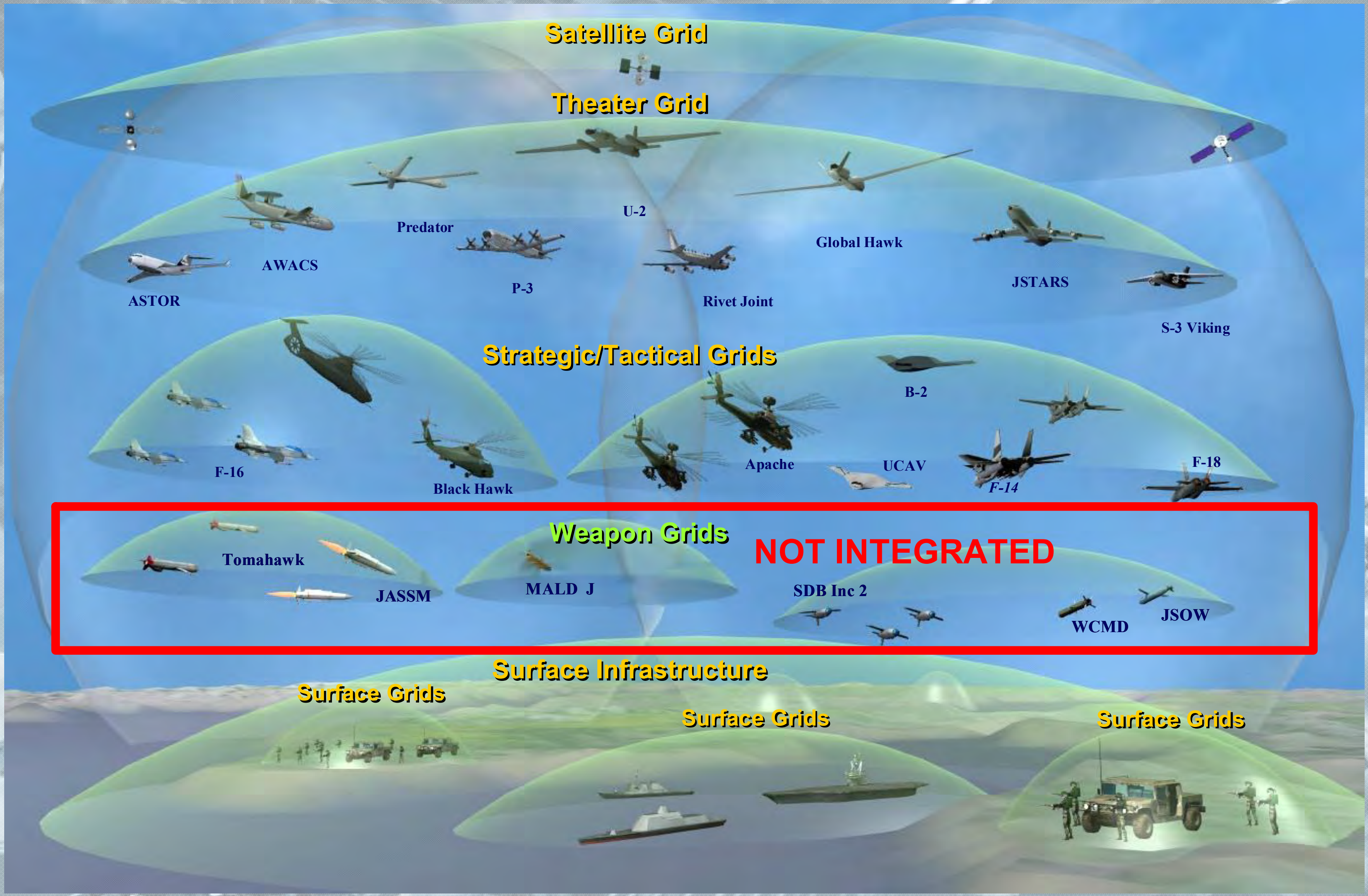
Re-usable

- DARPA FALCON Program
  - Phase I & II Common Aero-Vehicle (CAV)
  - Phase III Hypersonic Cruise Vehicle
- DARPA Re-usable Space Plane

Pervasive

- Air Force/Navy/Army/NASA/DARPA Versatile Advanced Affordable Turbine Engines (VAATE) Program begins 2005
- Army Hydrogen Scramjet Research
- DARPA/University of Queensland Collaboration
- Air Force/DARPA High Speed Turbine Engine Demonstrator (HiSTED) Program

Networked Weapons



Force Application ACTDs…
Big Enabler on the Battlefield!

- Net Centric Collaborative Targeting (NCCT)
  - Multi-INT Targeting Short On-Time Threat Emitters
- Thermobaric Weapon (Eglin/DTRA Team)
  - *ACTD Team of the Year – 2005 !!*
- Weapon Data Link Network (WDLN)
  - Realizing the great potential of an ‘integrated’ weapons grid
- Tunnel Target Defeat (TTD)
  - Strategic HDBT Defeat Planning/Targeting Tools
- Active Denial System (ADS)
  - Non-Lethal Force Application capabilities
- Advanced Tactical Laser (ATL) - SOCOM
  - Directed Energy Weapons on Airborne Platforms
- AC-130 SOF Precision Engagement
  - Precision Guided Weapons to SOF teams
- GRIDLOCK
  - Rapid Geo-registration of Motion Imagery

Force Application Needs for the Future

- QDR is mandating new capabilities
- Combating WMD… in all phases
  - Effective Agent Defeat
- STRATCOM's Global Strike / ISR / IO Mission
  - Prompt Global Strike (conventional capability) – Speed!!
- Robust HDBT Defeat Capability
  - Target sets going deeper
  - FCT: Programmable Intelligent Multi-Purpose Fuse (PIMPF)
- Geospatial Intelligence (Better Accuracy! / TLEs too large!)
  - Immediate targeting of battlefield sensors (UAVs Included) for rapid employment of GPS Weaponry
- Moving Targets – Advanced SAMs / Counter Maritime

WDLN ACTD Program Description

- **FY05 ACTD Program to Integrate Data Link Capability into Weapons, Sets Stage for Weapon Integration into Network Centric Warfare**
  - Risk Reduction for Weapon SPOs Data Link Programs
  - Develops Architectural Framework Supporting Current/Future Weapons Needs (2010, ~2020)
  - Establishes CONEMP and Common Network Interface
  - Identifies C2 and Aircraft Infrastructure Mods

Pathfinder for Network-Enabled Weapons Capability

Weapon Datalink Network

Problem

-- Weapon connectivity to ISR, C2 and Strike A/C needed for improved weapon precision, moving target engagement, responsiveness to TSTs, weapon tracking, weapon BIA and abort on command

Objectives

-- Define requirements for network weapon integration

-- Demonstrate network that provides weapon status, re-targeting, target updates, BIA

Technologies

-- AFRL ATD Weapon Data Link Transceiver

-- Miniaturized network transceiver suitable for captive flight testing

-- Network weapons message set

-- Standardized messages (uses, meanings, time slots) for C2, shooters, ISR, TACPs

-- Link 16 and/or UHF networks

Participants

-- ACC, AFMC (AFRL/MN & IF, Air Armament Center & Electronic Systems Center)

-- Navy (SPAWAR & NAVAIR)

-- DARPA

Schedule:

-- FY05/06 ACTD - FY07 Transition

Residuals

-- Requirements for C2 networks, initial CONOPS, Interface Control Document (ICD) defining network weapon messages

-- Weapon JTRS compliance definition

-- Pod for weapon/network integration testing

Comments

-- ICD invaluable for weapon datalink network-centric interoperability

-- Shortens F2T2EA kill chain for TSTs

-- Enhances weapon precision

Network-Centric Collaborative Targeting (NCCT)

FY 2001

Problem This Solves: Lack of PGM quality targeting information on mobile / relocatable time critical targets to support rapid engagement.

Solution: Horizontally integrate ISR platforms in a network centric environment to allow machine-to-machine collaboration on target identification and geolocation. Airborne SIGINT with MTI.

Participants: USCENTCOM, USAF, USA, USN, NRO

Schedule:

FY01-2Q04: Incremental phased development & assessment simulation & live-fly all platforms integrated on network

3Q04-05: Residuals and 'one year earlier than planned' transition

Status: All participants up on classified network integrating Systems Integration Labs (SILs). Running actual software on systems. Interim MUA completed at JEFX04 Summer 2004.
Army working GUARDRAIL participation for future inclusion into the net.

NCCT Focus

- **Orchestrate currently stand-alone SIGINT, GMTI, Imagery sensors to make them operate as a collaborative team via machine-to-machine interactions**
  - **Automated *cross cueing*, re-tasking of sensors, *correlation* of data**
- **Creates actionable information on fixed, stationary and moving surface targets with improved speed and accuracy**
  - **Single *collaborative NCCT track* within 1-2 minutes with 10x greater accuracy than single platform operations**
- **Focus on find, fix, track, and assess phases of kill chain**
- **Results provided rapidly to C2 decision makers**

TARGET ID			TARGET	ENGAGE	ASSESS
FIND	FIX	TRACK			

NCCT Rapidly Delivers Actionable Information on TSTs

Advanced Tactical Targeting Technology (AT3)

FY03 ACTD

Problem

- Timely air defense system destruction requires better detection ranges; emitter tracking; geo-location; targeting
- Objectives: Demonstrate an imbedded multi-platform ELINT capability

Technology

- **Digital receivers, distributed digital processing & netted sensors. Precise/stable TDOA/FDOA**
- **Residuals: Digital equipped, AT3 capable (ALR-69U RWR systems) F-16's in FY06**

Participants

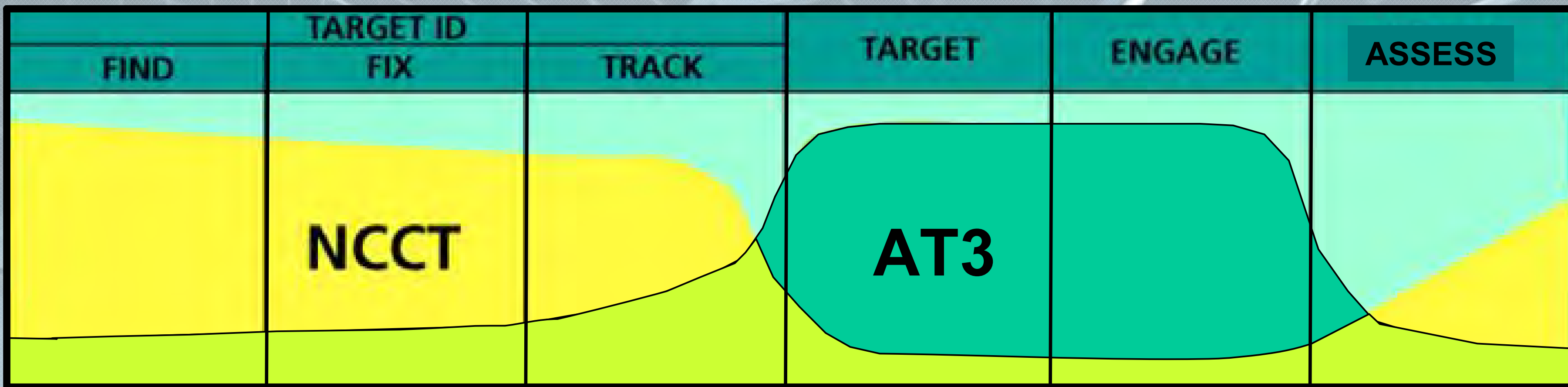
- **Lead Service: Air Force**
- **Sponsor: CENTCOM**

Schedule

- **Demo FY04-05**
- **Residual: FY06**

- **Enables GSTF/GRTF effects: neutralize, disrupt, degrade and access to denied areas**
- **Real-time precision targeting vs. time critical mobile/fixed targets without current LD/HD**

NCCT / AT3 Collaborative Effort



NCCT

- Orchestrate Stand alone SIGINT, GMTI and imagery Sensors To make them operate as a collaborative team via machine-to-machine interactions
- Creates actionable information on fixed, stationary and moving surface targets with improved speed and accuracy
- Focused on find, fix, track and asses phases of kill chain
- Result provided rapidly to decision makers

AT3

- Receive threat info from NCCT during ingress
- Generate rapid (real time) situational awareness
  - Single-ship and Multi-ship
  - Dispersed digital receivers within threat area
- Generate precision ID and Geolocation (target)
- Augment ROE requirements via NCCT
- Employ suppressive and destructive weapons (engage)
- Provide threat info to all players via NCCT

Bridging Activities (Phase 2)

Demonstrate:

- Wide area tactical network connection
- Joint/Coalition Operations in restrictive ROE
- Robust Destruction of Enemy Air Defenses

Challenges for the Future…

- **Theater TST** ***(can't get around the laws of physics!)***
  - To hit anything in a 600nm Theater in 10-15 mins… need a Mach 3.5 – 4 Weapon !
  - Need In-Flight Re-targeting / Re-Directing
- **Persistent ISR & Rapid Geo-Registration to support 'High- Speed' Weapons**
- **Alternatives for Speed Investment**
  - Seeker Investment (TLEs) / Stealth Investment (Loiter/Survive)
  - But… Doesn't get you to the Target quicker!!

Precision and Non-Lethal Weapons (NLW)

Precision Strike & Targeting Symposium

19 October 2005

Purpose & Overview

- **Purpose**
  - Discuss Non-Lethal Weapons in Support of the Warfighter
- **Overview**
  - Non-lethal History & Background
  - Required Effects & Current Solutions
  - The Future: An integrated approach

Forces Facing Situations…

- **Characterized by:**
  - Little or no indications and warning
  - High frequency of occurrence
  - Large number of unknowns
  - Low tolerance for causalities and collateral damage
  - Restricted rules of engagement & political sensitivities
  - Mission time criticality
  - Success or failure often measured in minutes or hours
- ***3-Block war***
  - Humanitarian relief on one block, crowd control on another and limited combat on another

Real World Examples

- "U.S. Marines shot and killed the driver of a vehicle speeding toward a military checkpoint in Port-au-Prince, Haiti. The Haitian driver of the vehicle was apparently just innocently driving his brother home from the airport."
- "U.S. soldiers shot into a crowd of thousands of demonstrators in a Baghdad slum on Wednesday, killing one civilian and wounding four ..."
- "An American soldier was shot [by sniper] in the head as he waited in line to buy a soft drink at Baghdad University today…"

Different Type of Need: NLW

DoD Directive 3000.3, 9 July 1996

- **Established the Joint Non-Lethal Weapons Program (JNLWP)**
- **Designated the Commandant of the Marine Corps as Executive Agent (EA) with the responsibility for:**

  "…providing program recommendations and for stimulating and coordinating joint non-lethal weapons requirements."

Joint NLW Directorate (JNLWD)

- **Marine Corps established JNLWD to support Joint NLW development**
- **Since that time the JNLWD & the services have:**
  - Conducted a number of concept exploration programs
  - Funded R&D initiatives
  - Fielded NL equipment

NLW Definition

Non-Lethal Weapons as defined by DoD Directive 3000.3 are:

"Weapons that are explicitly designed and primarily employed so as to incapacitate personnel or materiel, ***while <u>minimizing fatalities, permanent injury to personnel, and undesired damage to property and the environment</u>*****."**

Desired Effects

Category	Desired Effect	Examples
Counter Capability	Disable, Render Inoperable, Degrade, Suppress Equipment (reversible without external intervention)	• Offensive Electronic Warfare • Jammers
Counter Materiel	Disable, Render Inoperable, Degrade, Suppress Equipment (reversible with external intervention)	• Vehicle nets • Surface treatments
Counter Personnel	• Distract and/or disorient • Incapacitate (Render individuals incapable of acting or reacting)	• Blunt trauma • Flash-bangs, stun grenades • Riot Control Agents (RCA) • Neuro-Muscular Disruptors (NMD)

Not Much Out There…

Some Reasons:

- Other financial priorities
- Warrior mindset
- Focus on making the effect non-lethal
- Chemical treaties
- ACLU – easier to develop lethal systems
- Defining human responses
- Scaleability
- Practicality of combining lethal with non-lethal

WBB Recommended NLW Future

- **Not currently part of JNLWD strategy**
- **Based on supporting non-lethals over last 6 years**
  - Conducted multiple service & COCOM NLW Integrated Process Teams
  - Developed & analyzed Service Requirements
  - Developed Concepts of Employment
  - Conducted & analyzed user evaluations
  - Supported NLW Acquisition Community

Improving NLW Progress

Focus on meeting objective of DoD 3000.3 to minimize collateral damage, injuries & death

– Primary driver should be the desired end-state vice the means

– Adopt an integrated approach

Integrated Approach

1. Continue to Develop actual NL effects
2. Include development of enablers such as optics, target acquisition sensors, etc (not responsibility of JNLWD)
3. Improve precision of NLW
4. Employ precision lethal systems that meet the objective of DOD 3000.3

1. Continue to Develop NL Effects

Examples: (graphic)

- **Neuro-muscular Disruptors**

  - Incapacitate personnel
  - Need extended range, multi-shot
- **Active Denial System (ADS)**

  - Dissuade effect – skin burning sensation
  - Need small, light weight

2. Include Enablers

- **Intelligence, Surveillance & Reconnaissance**
  - Enhanced Situational Awareness
  - "See/sense" through walls (graphic)
  - Determine intent
  - Target acquisition sensors
- **C2**
  - Enhanced connectivity with individual & small unit

3. Improve Precision of NL

- **Increase precision of**
  - Current non-lethal weapons
  - Future non-lethal weapons (graphic)

4. Employ Precision Lethal

- **Directed Energy**
  - Advanced Tactical Laser (ATL)
  - Pulsed Energy Projectile (PEP)
  - Laser Guided Energy (LGE)
- **Kinetic Energy Weapons**
  - Individual or crew served weapons that use precise targeting

Benefits of an Integrated Approach

- **Accomplishes Mission**
- **Reduces Risk to Warfighter by Providing:**
  - More situational awareness to friendly forces
  - Less reaction time to threat
  - Improving targeting and precision of lethal systems
  - More certain results - instantaneous
- **Reduces Unintended Effects (Personnel & Infrastructure)**
- **Reduces Risk of Catastrophic Consequences (lethal if necessary)**

Benefits (cont)

- **Applicable to Entire Spectrum of Conventional Warfare**
- **Minimize Log Burden – scaleable effects in integrated approach**
- **Simplifies Shooters Decision Process - “Lethal vs NL”**
- **Builds Confidence in Warfighter**

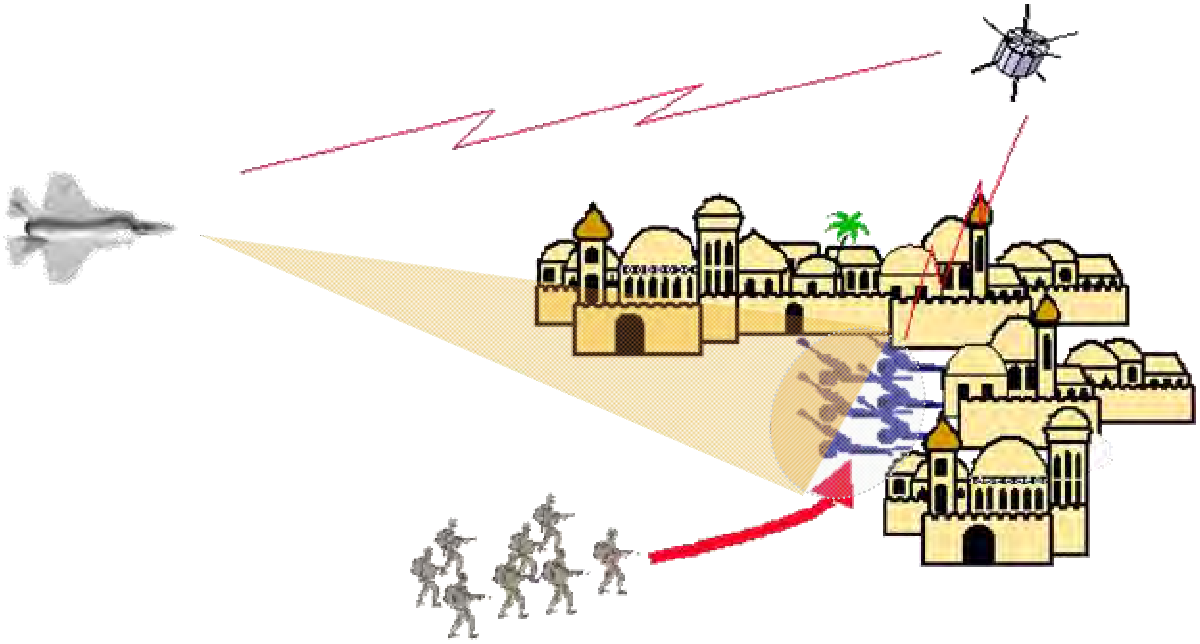
Keeps the fight in warfighter

Summary

- **NLW Program trying to meet DoD 3000.3 objective to minimize collateral damage, injuries & death**
- **Current status**
  - Many factors contribute to slow progress
  - Requirements just beginning to be documented in new Joint Capabilities Integration & Development System (JCIDS)
  - ADS ACTD and some DE R&D being conducted
- **Future**
  - JCIDS Requirements established
  - Commitment by Services & Industry to expand development and fielding of integrated NLW solutions

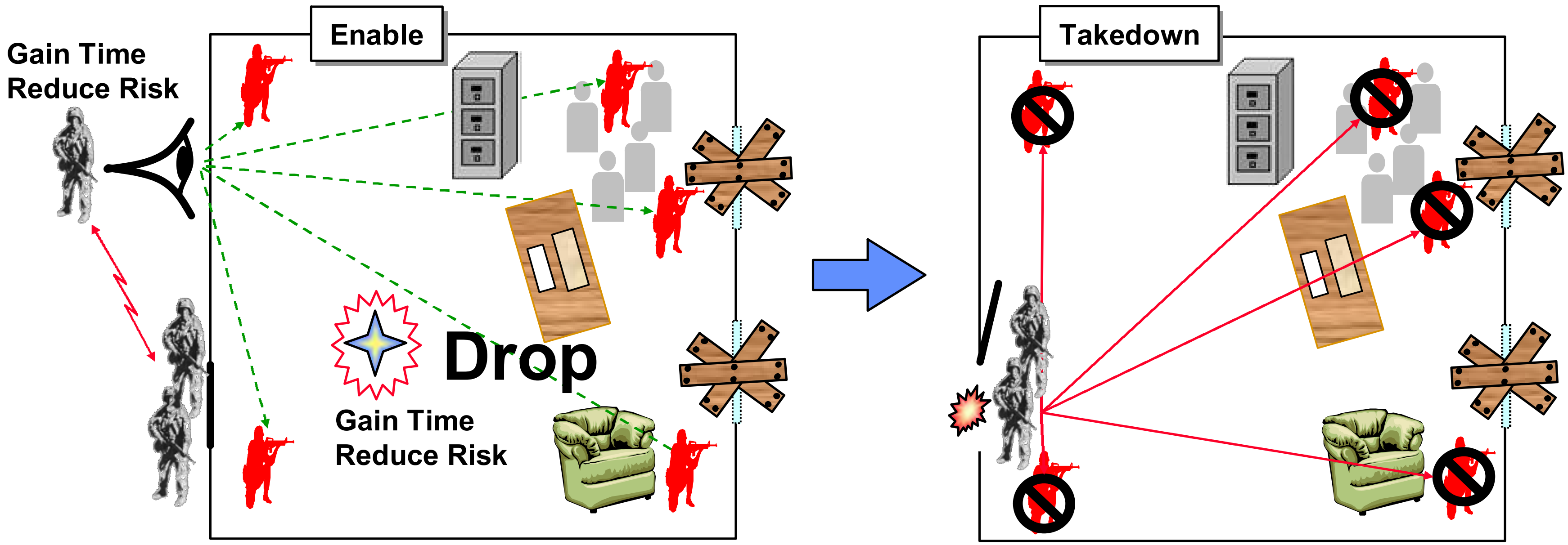
Backup

Area Target Example



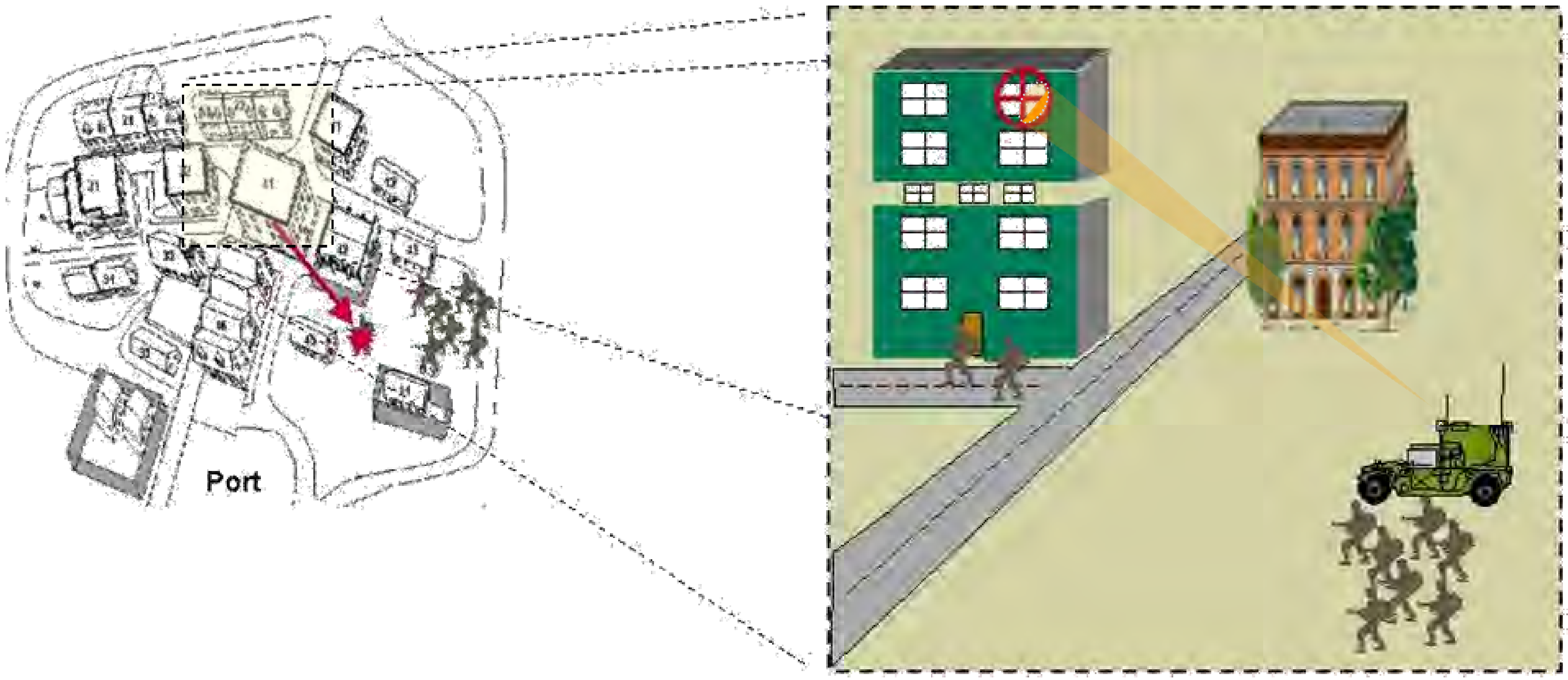
- Plan a coordinated attack with NLW in support
- Employ standoff non-lethal effects that render the entire threat battery and occupants ineffective
- Send in assault team to destroy artillery weapons and eliminate threat

Clear Space by Entering Example



- Obtain situational awareness (sense through walls)
- Introduce a setup device to Incapacitate
- Enter & identify threat target
- Engage with takedown device (NLW or precision lethal weapon)

Point Target



- **Determine Forward Observer location through intelligence & other means**
- **Engage and render ineffective with standoff effects that can be used among noncombatants**

Advanced Tactical Laser (ATL)

Description

- Modular high-energy laser weapon system on C-130 aircraft (AFSOC Mission Scenarios)
  – Day/Night capability
  – Adjustable laser dwell time

Military Applications

- Area delay/denial to vehicles
- Vehicle interdiction
- Counter capability/material
- Ultra-precision strike

Mission Tasks

- Deny/defend area
- Engage threat

ATL C-130

Pulsed Energy Projectile (PEP)

Description

- Mobile
- Extended range
- NL, counter-personnel
- Multiple/tunable target effects (distract, deter, disable)
- Creates plasma detonation close to body. Effect depends on power

Military Applications

- Delay, Distract/disorient, Incapacitate
- Denial to Controlled Areas
- Separate Belligerents

Mission Tasks

- Crowd Control
- Engage Threat
- Deny/defend area

PEP Integration CONCEPT

Rules of the Game Changed…

- **Mission environment**
  - Foreign soil
  - Small scale, localized
- **Rules of Engagement**
  - Very Strict
  - Positive Identification
  - Zero collateral damage
  - Eliminate risk to own force and non-combatants
- **NLW focus**
  - Weapons/effects for small units/individuals

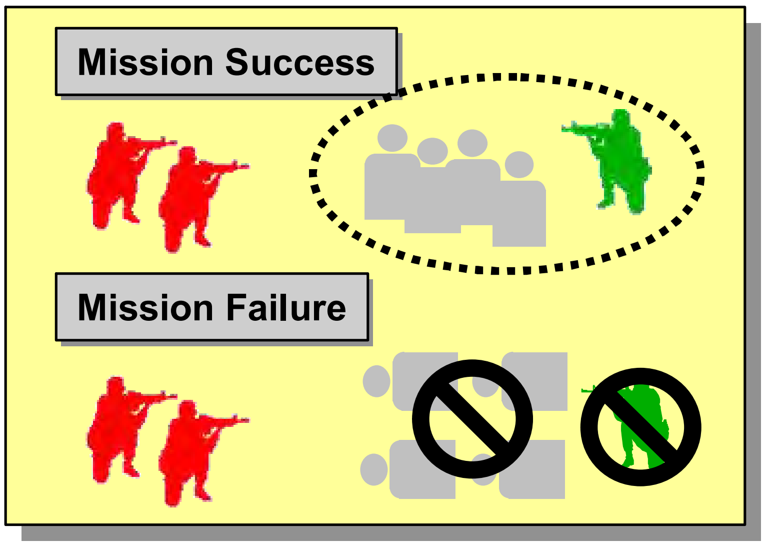
- **Mission environment**
  - Universal
  - Global war
- **Rules of Engagement**
  - Less strict
  - Identification
  - Minimize collateral damage
  - Minimize risk to own force & non-combatants
- **NLW focus**
  - Broad, holistic, integrated & interoperable Family-of-Systems

…and the Stakes Were Raised

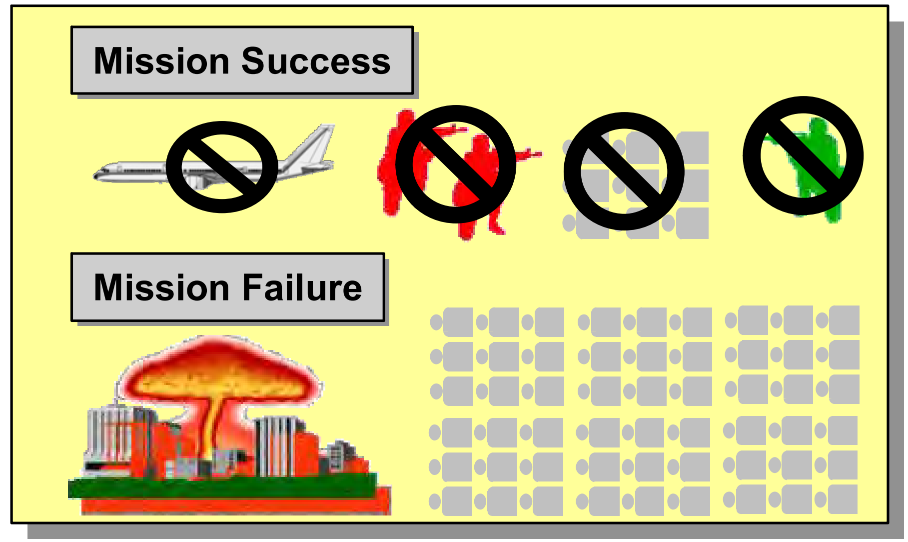
Example: Hijacking

11 September 2001

Before



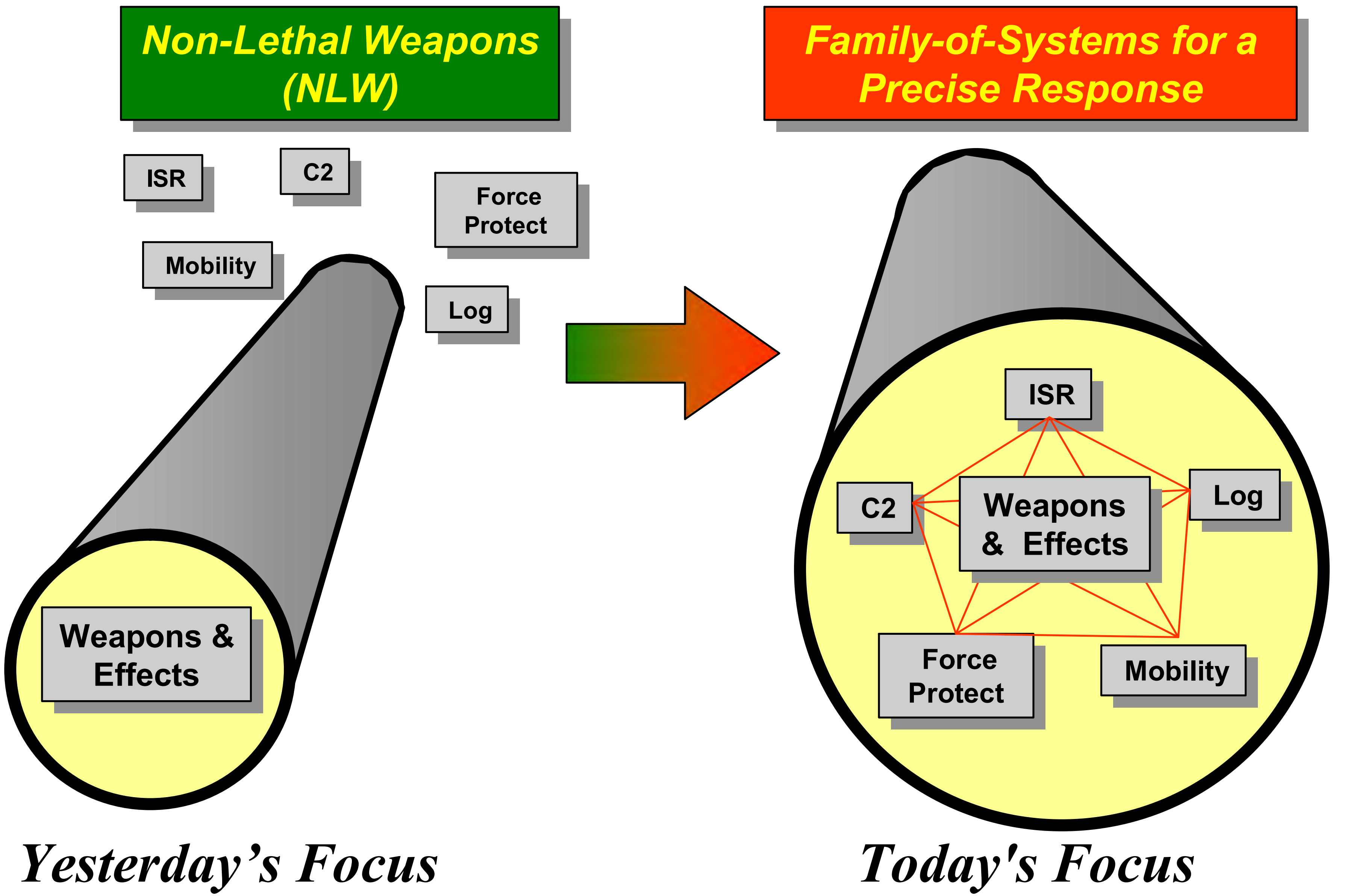
After



- **Mission Success**
  - ✓ Non-combatants safe
  - ✓ No friendly casualties
- **Mission Failure**
  - ✓ Non-combatant casualties
  - ✓ Blue Force casualties

- **Mission Success**
  - ✓ Eliminate threat (deny, degrade, disrupt, disable, destroy)
- **Mission Failure**
  - ✓ Terrorist accomplishes mission

To Achieve Goals - Focus Must be Integrated



Precision Strike Association

Accelerating Precision Strike Technology for Stability Operations and Protection of Coalition Forces

Keith Sanders
Program Executive Officer
Strike Weapons and Unmanned Aviation
18-20 October 2005

AARGM

Key Capabilities

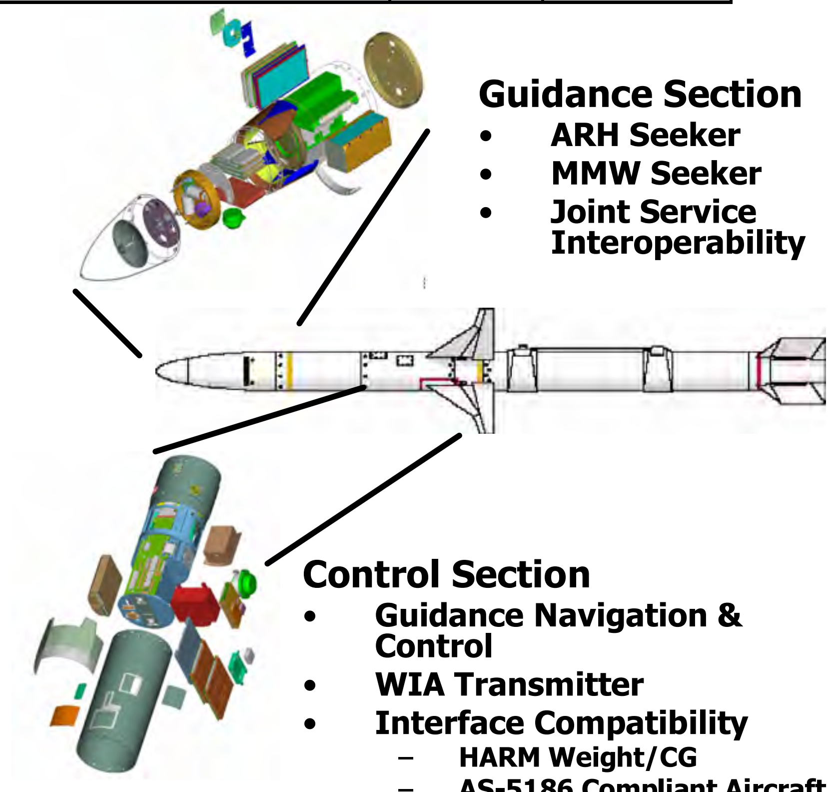
- **Counter Shutdown**
  - Active Millimeter Wave (MMW) guidance
- **Expanded Threat Coverage**
  - Enhanced Anti-Radiation Homing (ARH) receiver
- **Netted Targeting**
  - Real-time Intel feed via Integrated Broadcast Service Receiver (IBS-R)
  - Weapon Impact Assessment (WIA) transmitted prior to detonation
- **Geospecificity**
  - GPS/Point-to-Point Weapon
  - Impact Avoidance Zones (IAZ)/Missile Impact Zones (MIZ)
- **Multi-Spectral Guidance to Kill**
  - ARH, MMW, GPS

Acquisition Objectives

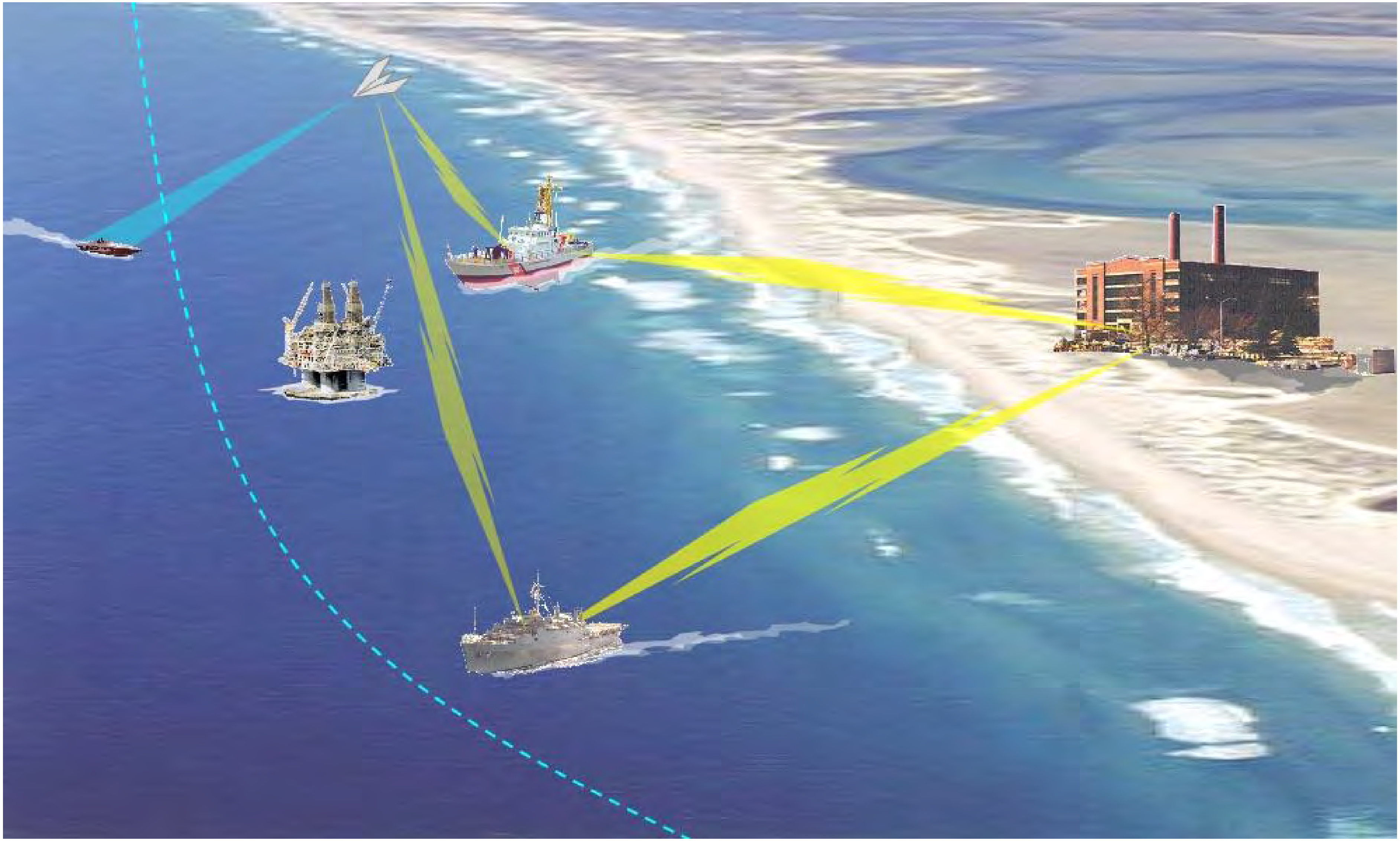
• **Quantity**	**1750**
• **IOC**	**FY09**
• **Target Price (Unit FY03)**	**$475K**
• **Next Milestone (FEB 06)**	**CDR**

Operational Modes

Mode	HARM	AARGM
Emitter Engagement	X	X
Exclusion Zones		X
Stationary Non-Emitter		X
Moving Non-Emitters		X
BDA Support		X



UAV Support for Maritime Security



PF28505a

Dynamic Re-planning
(JMPS in the cockpit)

Airborne Replanning

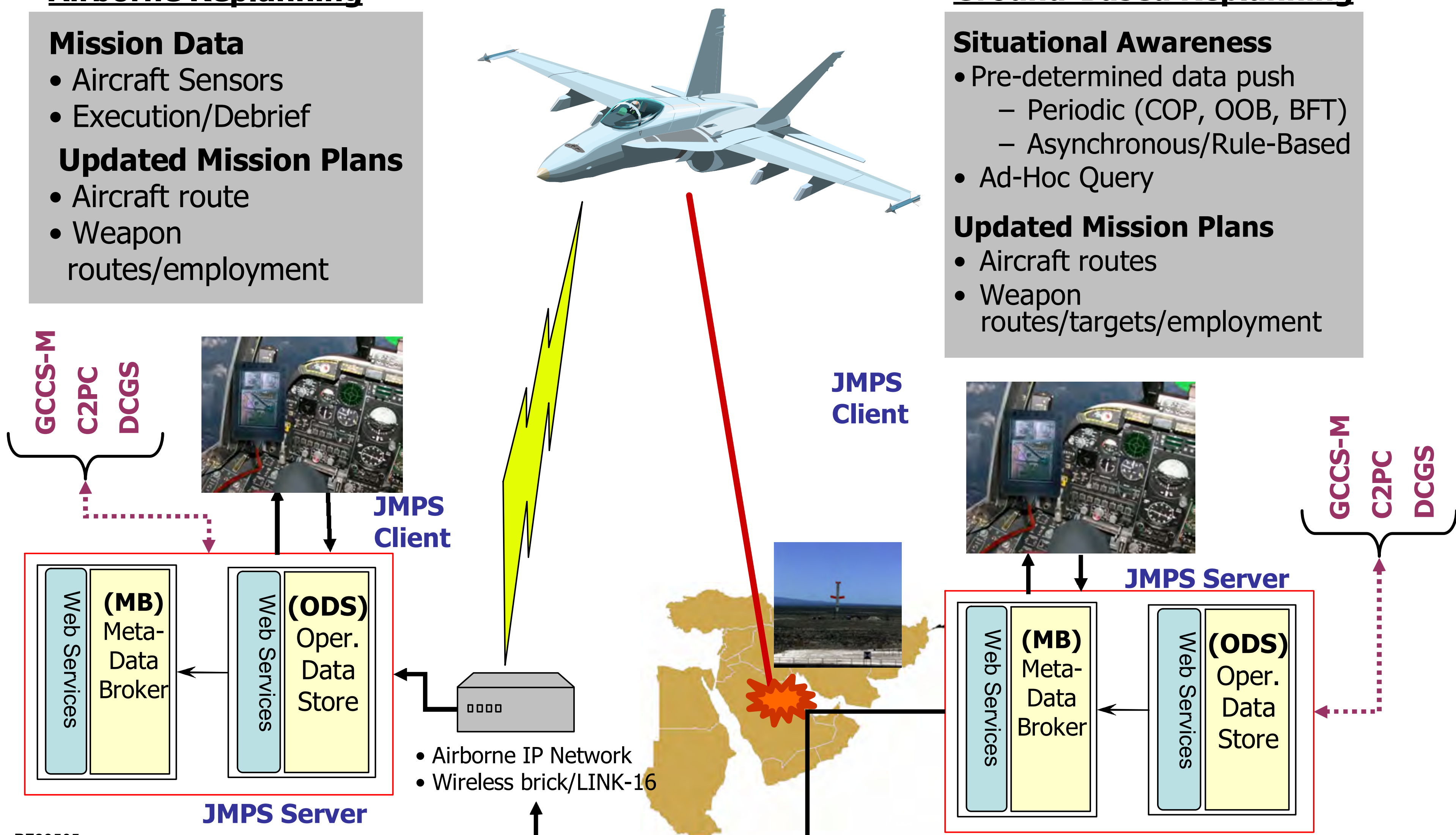
Mission Data
- Aircraft Sensors
- Execution/Debrief

Updated Mission Plans
- Aircraft route
- Weapon routes/employment

Ground-Based Replanning

Situational Awareness
- Pre-determined data push
  - Periodic (COP, OOB, BFT)
  - Asynchronous/Rule-Based
- Ad-Hoc Query

Updated Mission Plans
- Aircraft routes
- Weapon routes/targets/employment



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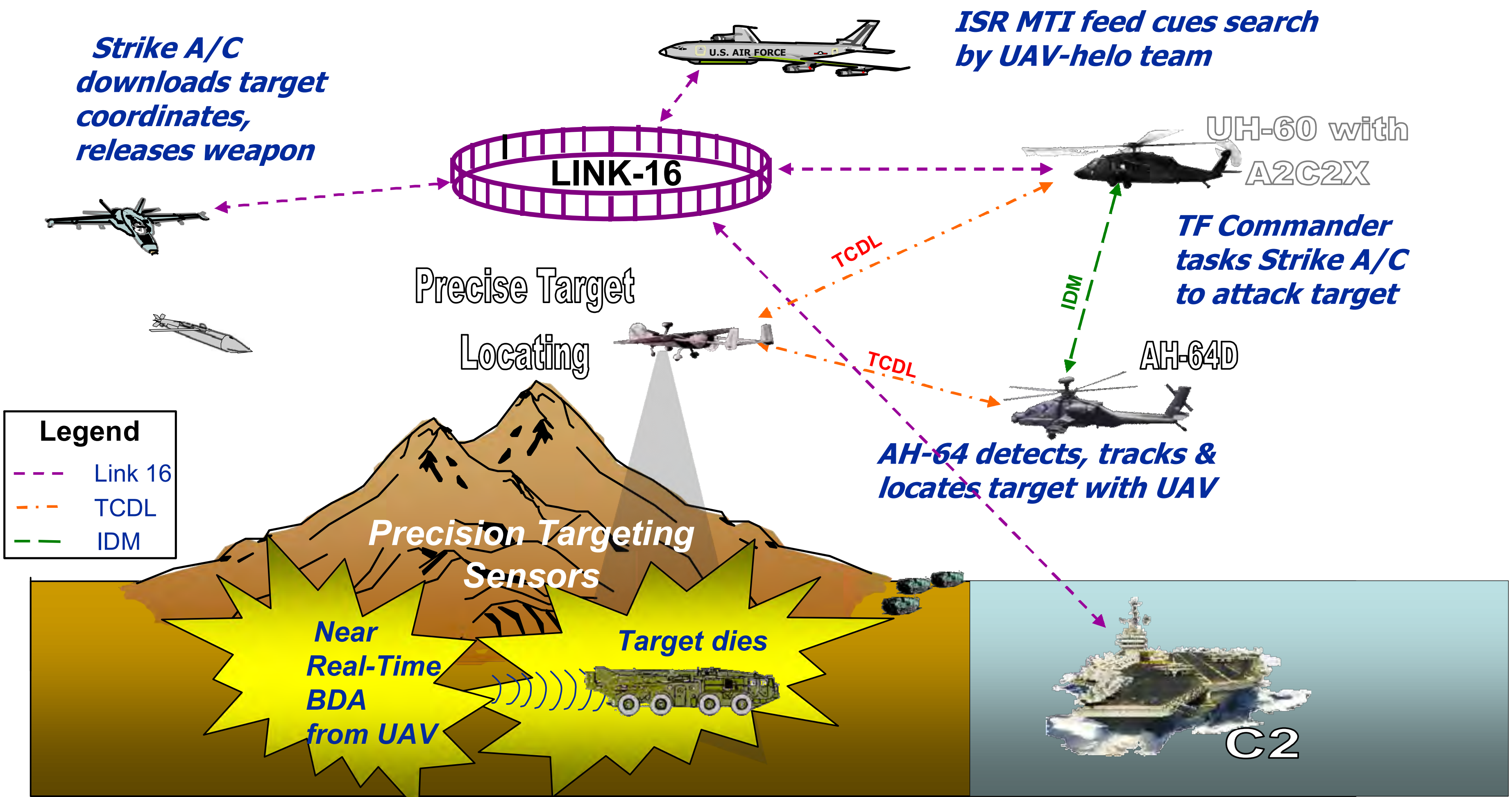
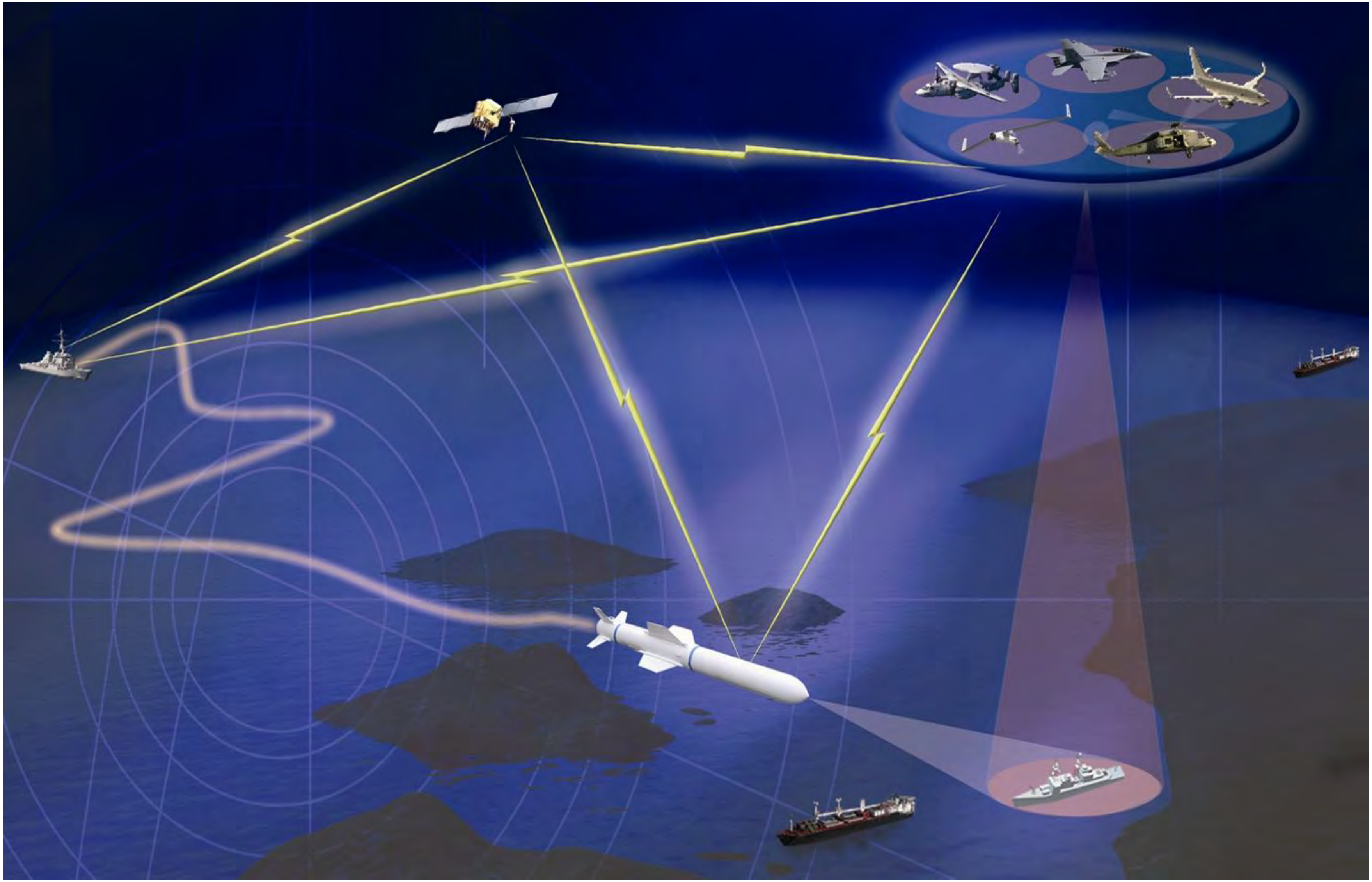
Hunter Standoff Killer Team ACTD Sample Employment Concept



ACTD enables direct feedback between operational units and technology developers as "good ideas" get put to the warfighter test!

PF28505a

Harpoon Block III



PF28505a

Summary

Accelerating technology to solve existing problems requires:

- ***Accelerating non-materiel aspects of a solution, too***
- ***Building user confidence via demonstrations***

Precision Strike Technology Symposium

JSF Pneumatic S&RE and Beyond

19 October 05

Mr. Lynn D. Seal

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GLOBAL TECHNOLOGY REACH
Defense Systems

Abstract

Existing pyrotechnic ejection racks use erosive pyrotechnic cartridges to release weapon stores. The explosive nature of pyrotechnic cartridges causes pitting damage and residue build-up in the racks which increases required maintenance, decreases rack performance, and reduces the overall life of the rack. Also, pyrotechnic cartridges have associated storage, inventory, handling and disposal/hazardous waste clean-up costs, which significantly add to life cycle costs. Thus, when the JSF efforts began, the program office required that the S&RE suite for the aircraft be non-pyrotechnic. This requirement resulted in studies that determined pneumatic powered S&RE would best meet the JSF needs. This presentation illustrates the approach used for the JSF bomb racks and eject missile launchers and the hardware/protocols used for the pneumatic compressor and logic control, respectively, and presents future applications for pneumatic powered S&RE.

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Biography

Lynn D. Seal

Manager, Advanced Armament

EDO Corporation

Mr. Lynn D. Seal graduated in 1965 from Case Institute of Technology with a B.S. in Metallurgy. Upon graduation, he spent four years in the United States Air Force as an aircraft maintenance officer on C-130 aircraft. In 1969, Mr. Seal joined Dayton T. Brown, Inc. Testing Laboratories, where for the next ten years he was responsible for the testing of aircraft armament equipment and systems, as well as being a member of various industry and government armament groups. Mr. Seal joined EDO in 1979 and has since been intimately involved with all armament production which includes the Tornado, F-15E, F-22, BRU-57, JSF, SDB and B-1B PAR Programs, as well as all R&D efforts and continued involvement with armament groups.

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History and Leveraging Technologies

- **Air Bag Ejection (FO8635-84-C-0317)**
  - ***Northrop***
  - ***Air Bag Expands to Eject Store and Fill Opening***
- **Conformal Ejector Rack (FO8635-84-C-0317)**
  - ***Rockwell***
  - ***Remote-controlled, Hydraulic Rack with Self-contained Hydraulic System***
- **Alternate Conformal Ejector Rack (FO8635-85-C-0170)**
  - ***EDO***
  - ***Remote-controlled and Self-contained Pneumatic/Hydraulic Rack***
- **Advanced Missile Ejection Launch Technology (FO8635-86-C-2085)**
  - ***MDA***
  - ***Hydraulic Powered Trapeze for AIM-120 Ejection***

History and Leveraging Technologies

- **Dual Mode Launcher (FO8630-92-C-0011)**
  - ***EDO***
  - ***Hydraulic Powered Trapeze for AIM-9 and AIM-120 Ejection***
- **Advanced Weapon Carriage Technology (FO8630-92-C-0012)**
  - ***Boeing/MDA***
  - ***Adoptable and Relocatable S&RE with Reusable Energy Sources***
- **Weapons Carriage Technology (FO8630-95-C-0010)**
  - ***Boeing/EDO/Vickers***
  - ***Pneumatic Powered Rack and Missile Launcher Combination***

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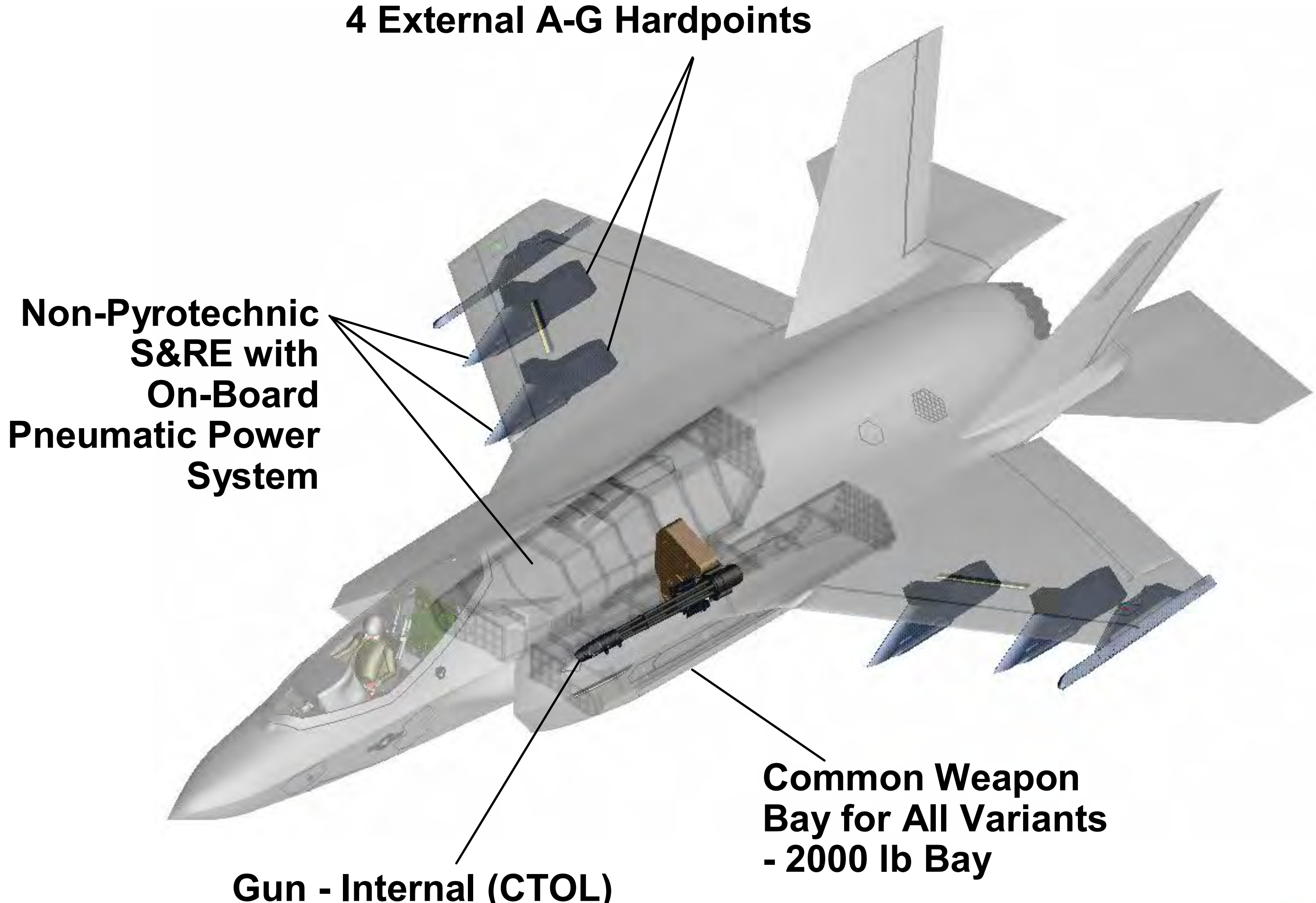
"The Bottom Line"

- **Pneumatics Win Out Over Hydraulics**
  - ***Legacy Aircraft Specifies "No Carts" for AIM-120 Launcher But Still Uses Pyro Racks***
  - ***JSF Specifies "No Carts" for Racks and Launchers***
  - ***SDB Specifies "No Carts" for its Multiple Store Carrier***

JSF Weapons Carriage Overview



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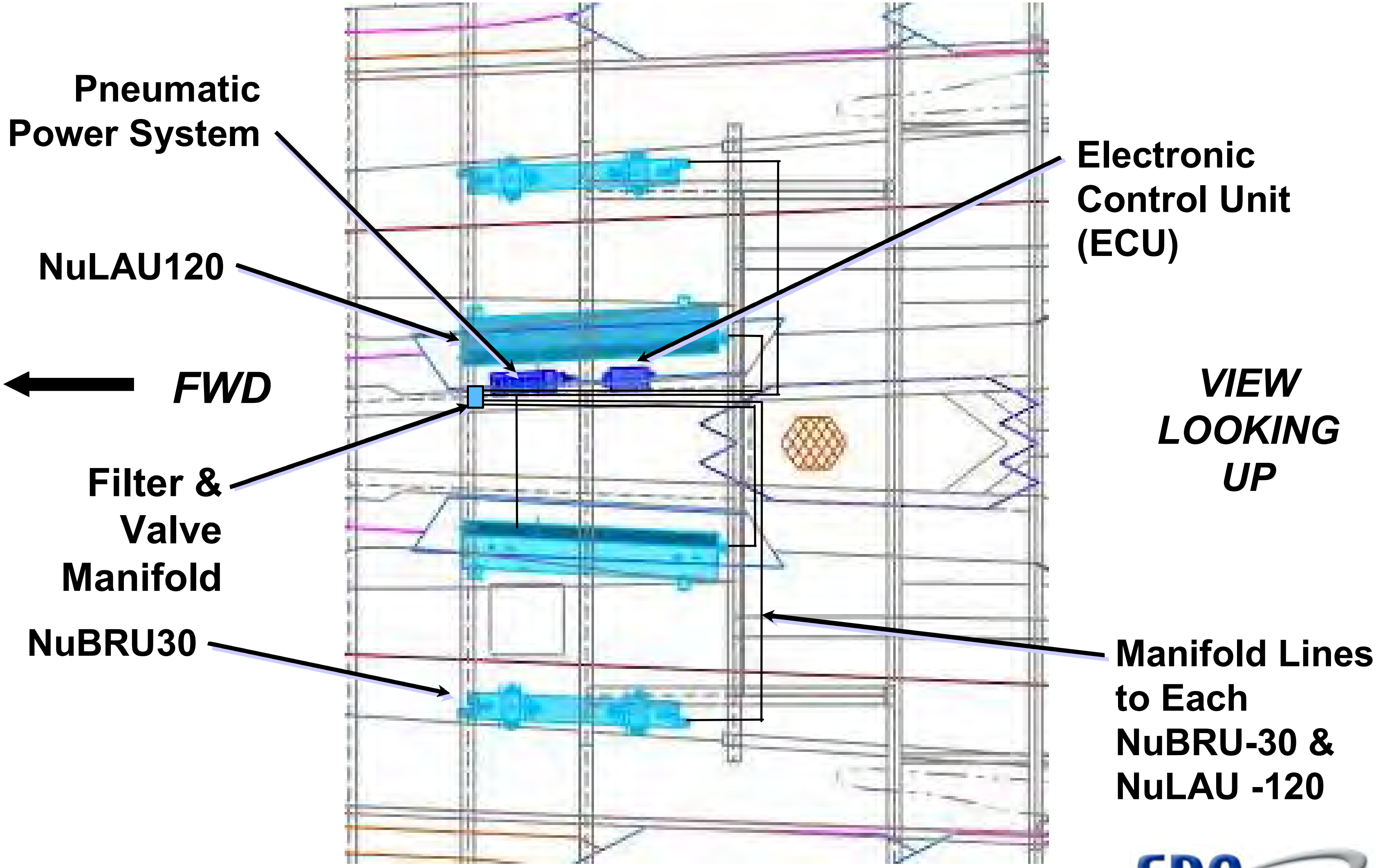
JSF S&RE System Weapon Bay Installation Schematic



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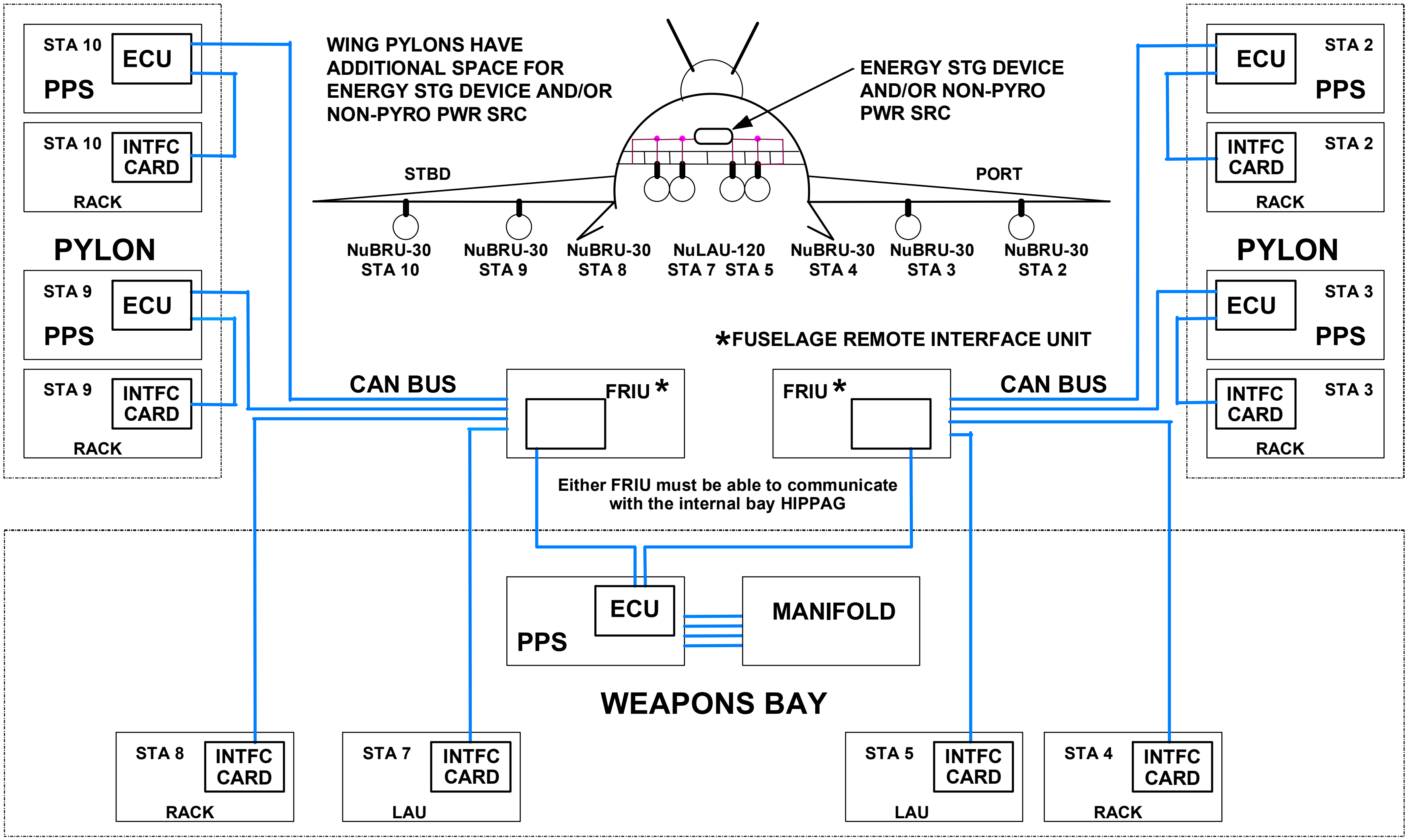
Overall Aircraft Interface



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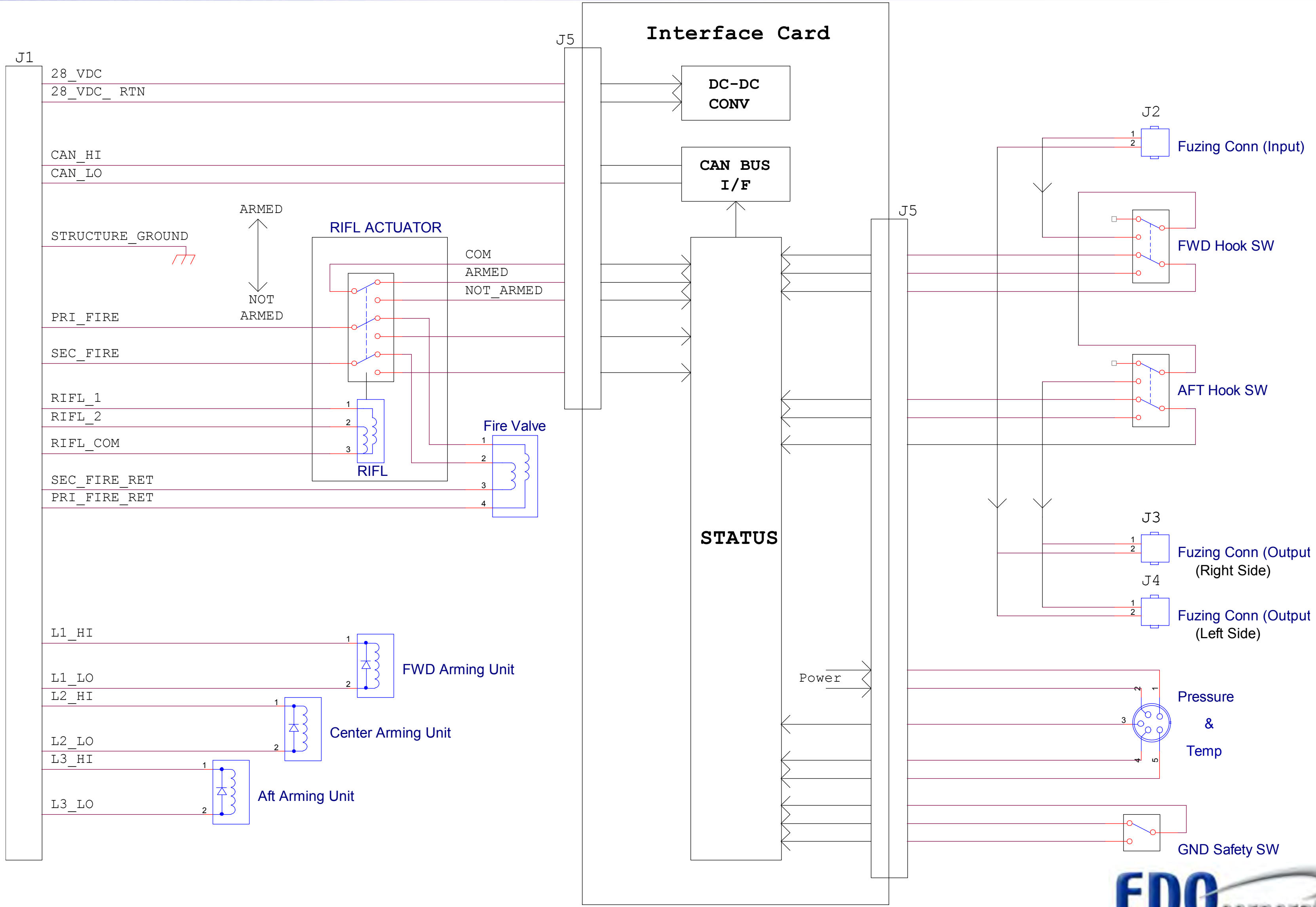
S&RE Electrical Schematic



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JSF Baseline Pneumatic Power System Configuration

- ★ 1x PPS, 4 racks for both bays
- ★ 1x PPS, 1 rack per wing pylon
- ★ Flow rate: 10 SL/min, at STP
- ★ Pressure: 5,000 psi
- ★ ECS Air Supply to the bay PPS: 14.7 psia
- ★ Bay, Filter Capacity: 24,000 S.Litres Air
- ★ Wing Pylon, Filter Capacity: 8,000 S.Litres Air

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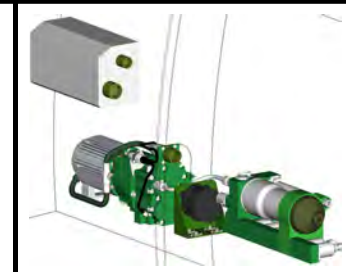
S&RE System Components (LRCs)

	14/30" Rack	Missile Ejector	PPS
			
Envelope (L x H x W)	36.0 x 4.0 x 5.63	39.6 x 4.0 x 6.9	
Max Weight (lb)	90.0	69.0	25.5
Min Eject Performance (ft/sec)			
350 lb Store		25.0	
500 lb Store	20.0		
1000 lb Store	15.0		
2000 lb Store	11.0		
Departure Control	Yes	Yes	
Stroke Length	7.5	7.5	
Aircraft Uses	Int : All Ext : All	Int A/A : All	Int : All RH Bay Ext: All Pylons

Note: **STOVL will now use 14" only rack for weight considerations**

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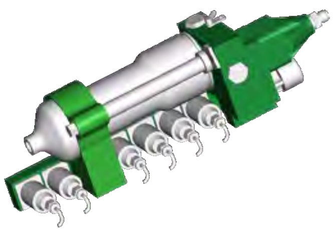
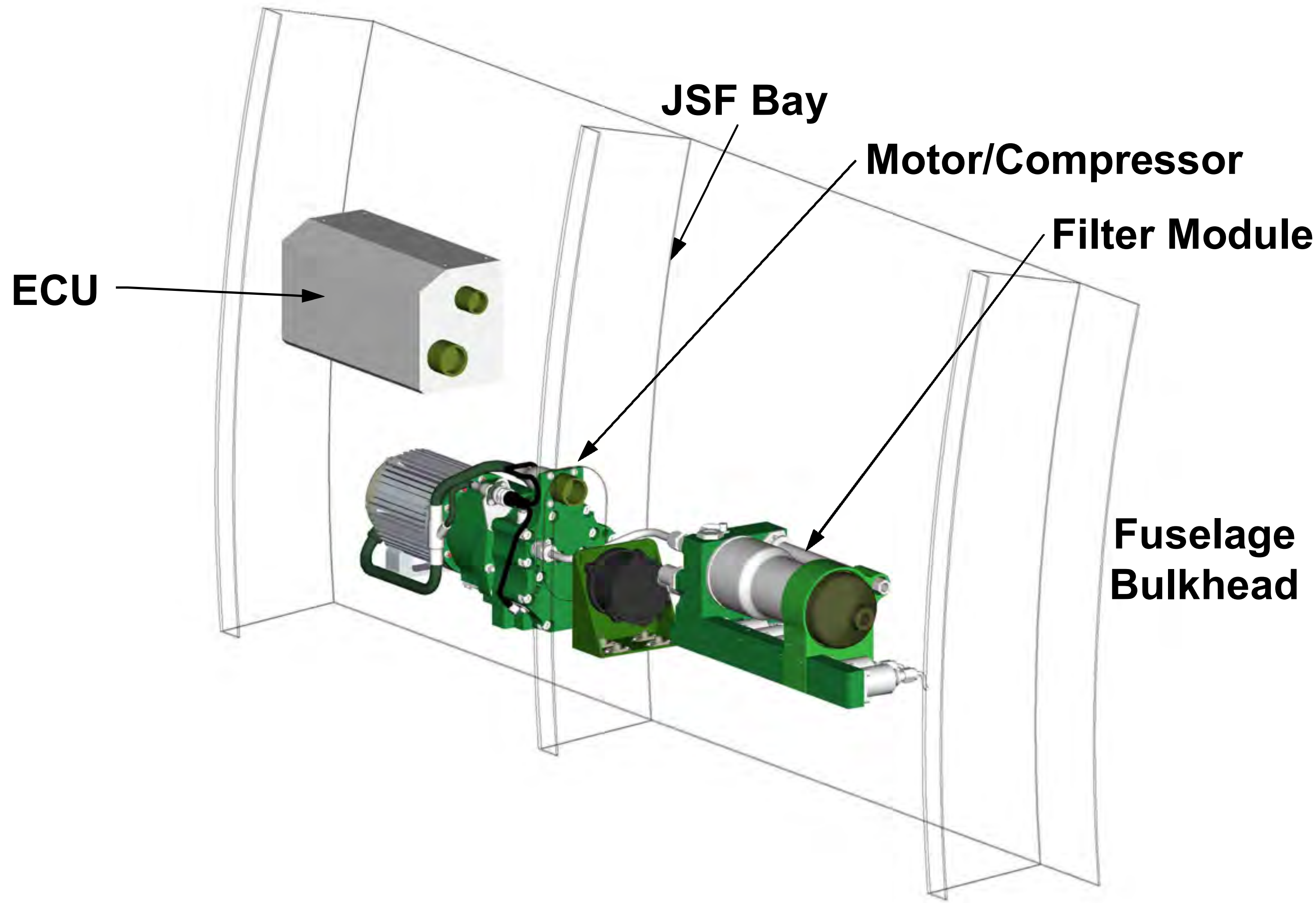
Pneumatic Power Source (PPS) Components (LRCs)

	Compressor	Filter/Manifold	Electronics (ECU)	Pylon Filter
				
Envelope (L x H x W)	11.00 X 3.54 X 4.10	13.50 X 3.51 X 3.91	9.00 X 3.15 X 3.54	5.30 X 4.13 X 4.76
Weight (lb)	11.4	9.5	4.6	3.8
Electrical Power	540 Watts@270VDC			
Aircraft Uses	Int : All RH Bay Ext: All Pylons	Int : All RH Bay	Int : All RH Bay Ext: All Pylons	Ext: All Pylons

PPS Bay Installation



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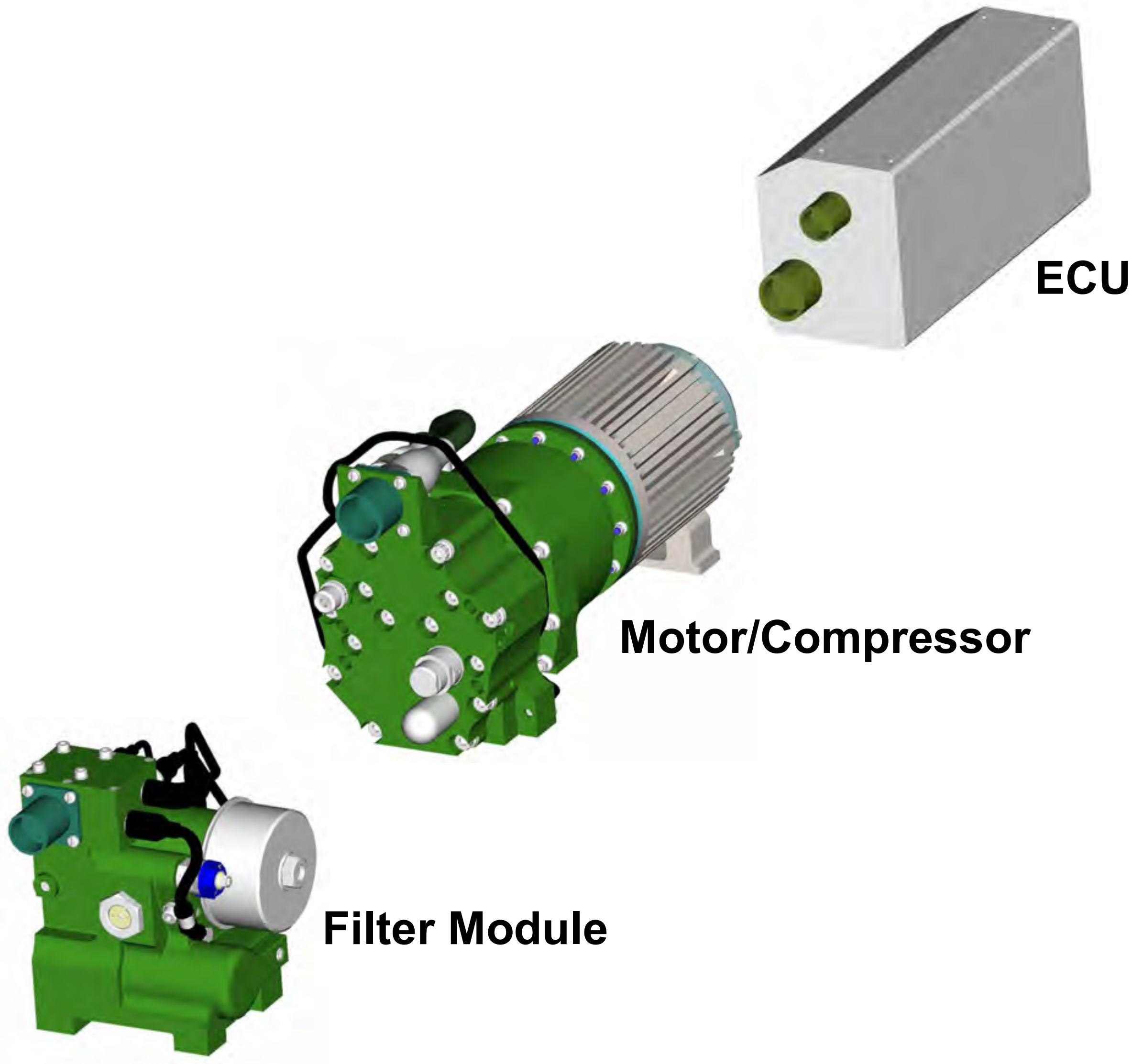
PPS For Pylon Installation



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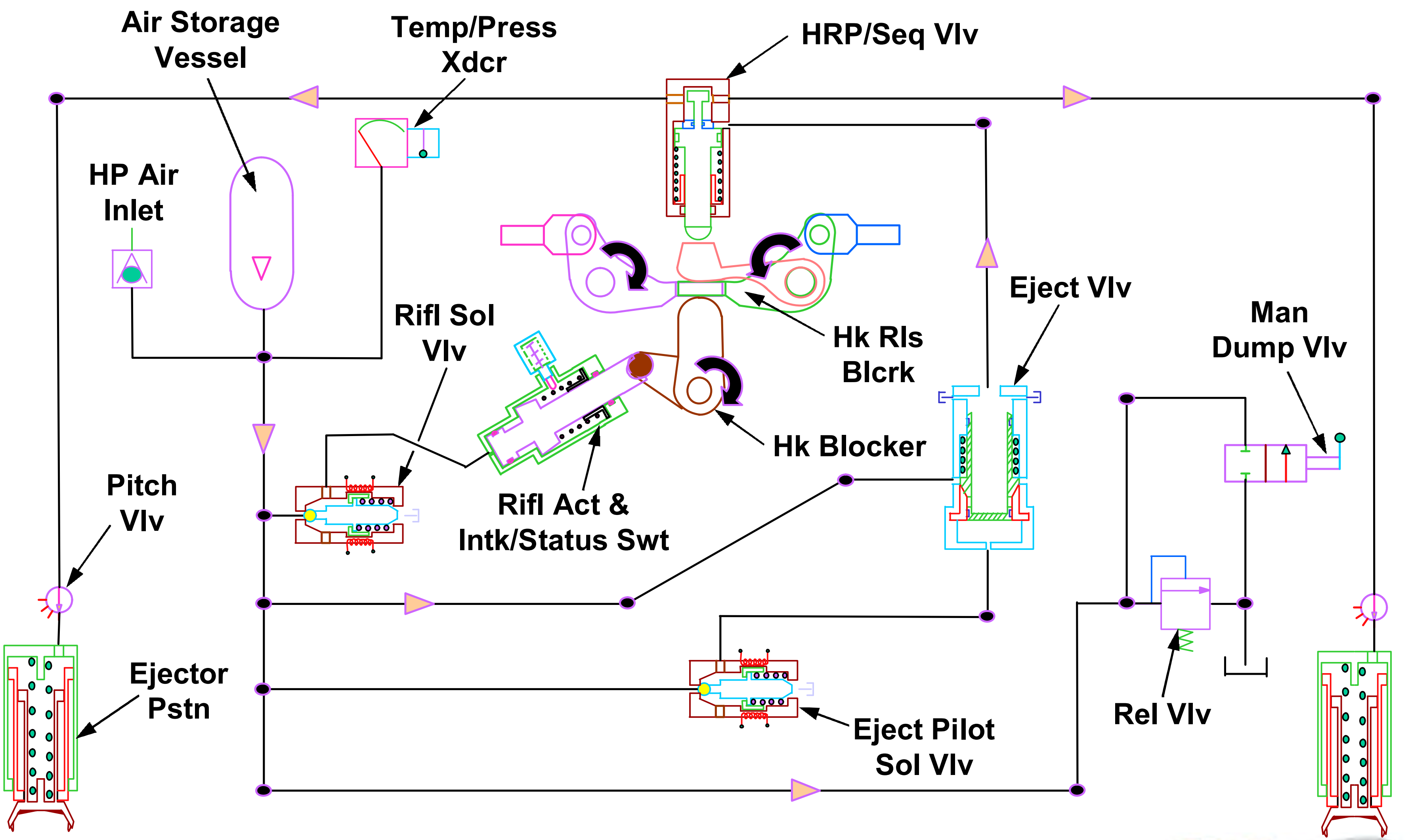
JSF S&RE Pneumatic System Schematic



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JSF S&RE Key Features/Concepts

- **Must Fully Charge Before Flight (Based on Emergency Jettison)**
- **Can Recharge During Egress**
- **Considering Manual Fill Point for Ground Carts**
- **Considering Having Off the Shelf Units Pre-Charged**
- **Pneumatic RIFL will Mechanically Block Hook Release Piston Even When Hooks are Open**
- **Manifold Distributes High Pressure Air to Particular S&RE Based on Need/Priorities**

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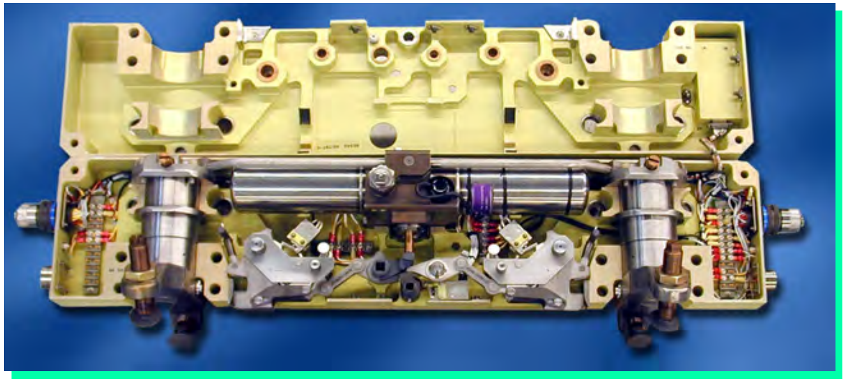
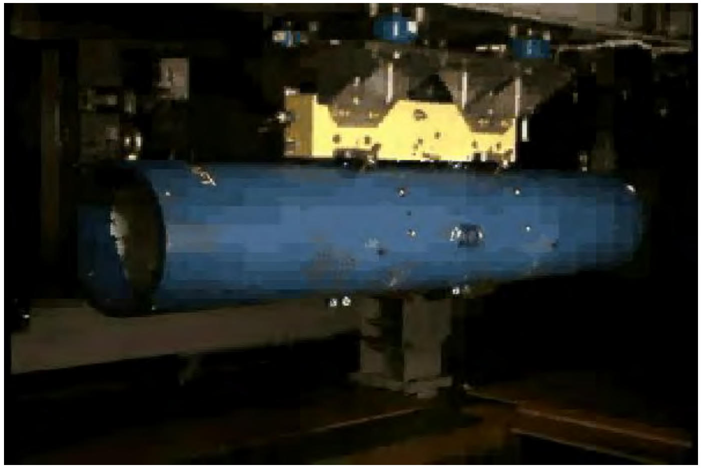
JSF S&RE Key Features/Concepts

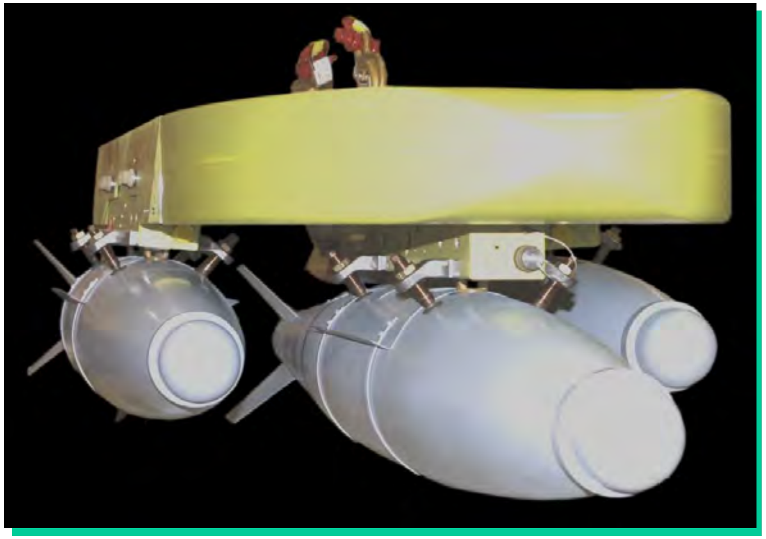
- Interface Card Collects All Data from S&RE's and Passes on to Aircraft for Health Prognostics Management
  - *Pressure*
  - *Temperature*
  - *Hook Status*
  - *Safety Status*
  - *Self Test/Bit Results*
  - *Host Rack Identification (BRU/LAU)*
- Fire and RIFL Solenoids Have Dual Coils
- Fire and RIFL Solenoids Fail Safe with Loss of Power by Venting to Atmosphere
- Common Electronics and PPS for BRU/LAU
- PPS Compressor Mounted on Coolant Plate

Pneumatic Technology IR&D Program to Verify JSF Concepts



Pneumatic Demonstrator





Strongback with Pneumatic Racks and 500lb JDAMS

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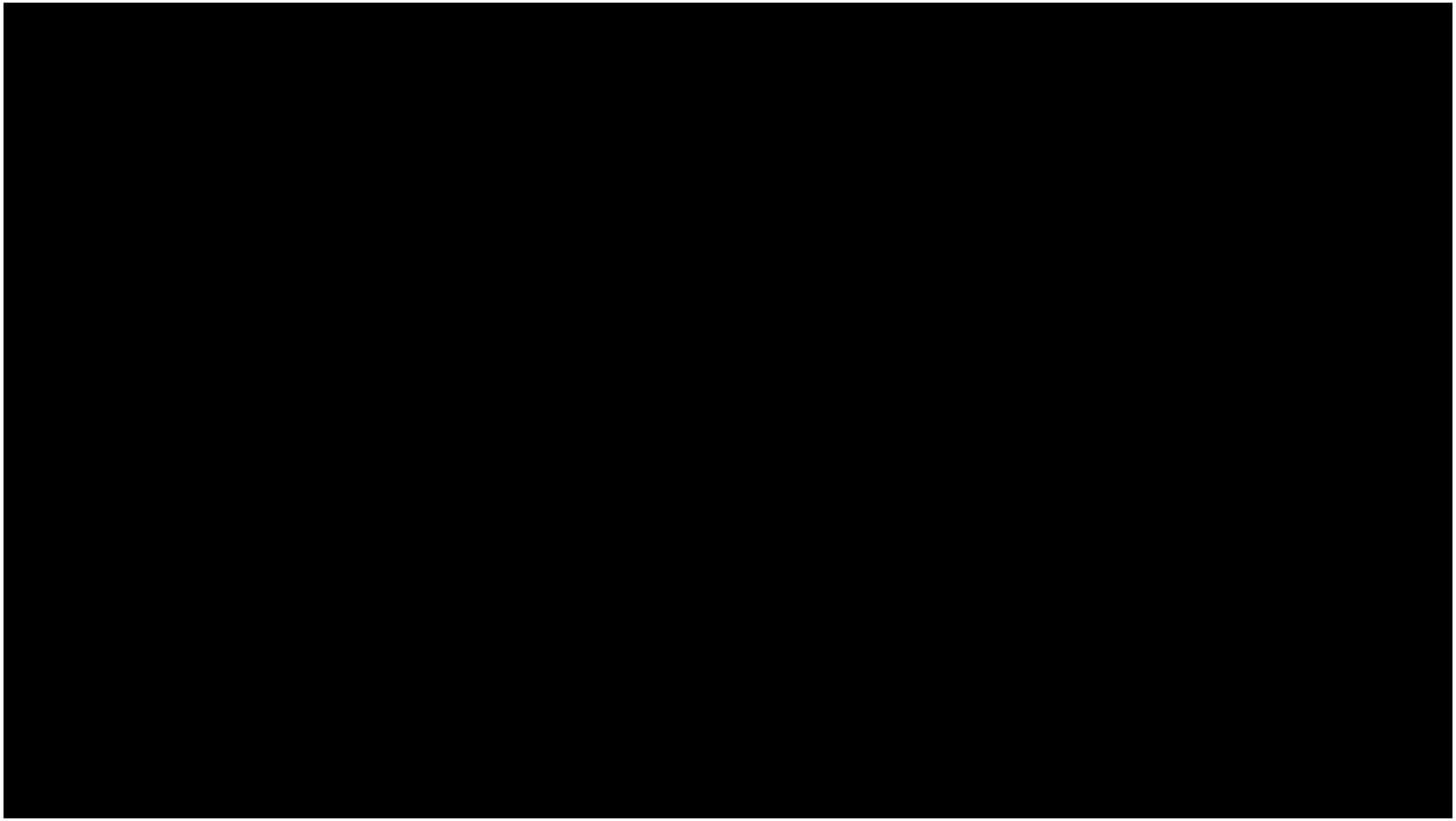
SCS Flight Test



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B-1B PAR Flight Test

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Pneumatic Rack S&RE Applications

- F-22
- SDB/BRU-61
- JSF
- MMA
- J-UCAS
- B-1B
- UAV's
- Twin Store Carrier

Decision Support for Time Critical Strike: Land Based Target Area Of Uncertainty (LBTAOU) Prototype

David Silvia
Naval Undersea Warfare Center
Newport, RI

Partnership

Research and development center for submarine systems, autonomous underwater systems, and undersea offensive/defensive weapons

Serves as a liaison between the University of Massachusetts Dartmouth (UMASSD) and industry, forming partnerships with regional technology-based corporations and laboratories, providing educational and research opportunities for UMASSD students

Objectives

- To evaluate the application of Geographic Information Systems (GIS)-based decision support technologies to address Naval Capability Gaps
  - Persistent ISRT for accurate target discrimination and location (gap no. 5)
  - Rapid movement of mobile/emergent target data to shooters (gap no. 7)
  - Persistent high speed strike weapon to engage time critical targets (gap no. 12)

Key To Time-Critical Strike Capability

"We need a decision-making aid with software where we can tie in ISR and factor in such things as rules of engagement and other sensitivities, blast fragment pattern [to avoid collateral damage], target priority, target location, etc. That would really shorten the time between identifying a target and getting permission to drop.... "

Rear Adm. (select) Joseph F. Kilkenny,
Office of the Chief of Naval Operations
www.navyleague .org

NAVSEA NEWPORT Undersea Warfare Center Division

Areas of Interest

- Time-critical, mobile targeting
  - Support High Speed Weapon and advanced versions of TacTom
- Integrated Land Attack
  - Assess tactical application for mission planning, loiter planning, and increasing situational awareness for the shooter
- Common Human Computer Interfaces (HCI)
  - Evaluate the use of GIS as a common presentation layer for complete situational awareness
- Develop solutions that extend to other tactical areas
  - Unmanned Aerial Vehicle (UAV) search planning
  - Unmanned Combat Aerial Vehicle (UCAV) targeting
- Examine and apply Artificial Intelligence to GIS applications
  - Apply Fuzzy Logic to spatial analysis
  - Predict target movements based on mission/intent

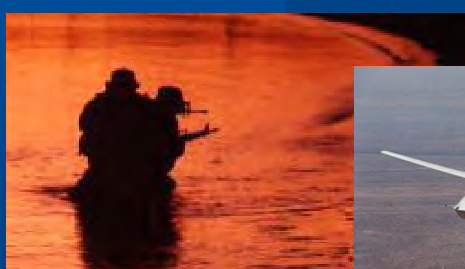
Tomahawk Background

- Block III
  - Used against high-priority, long-dwell targets
- Block IV or Tactical Tomahawk
  - Initial Operational Capability FY04
  - Additional capabilities
    - Satellite communication
    - In-flight retargeting
    - Loiter capability
    - Health and status reporting

The Problem

Limited capability against mobile, time-critical targets

- Weapons cannot be recalled, unlike an Unmanned Aerial Vehicle (UAV)
- Short endurance limits ability to loiter
- Call-For-Fire (CFF) requests
  - Require detailed mission planning
  - Response time may be significant
- During in-flight time, a target need only move a short distance to evade strike




Approach

To provide a tool that allows mobile targets to be quickly relocated/retargeted via an optimized search route based on :

Target Capabilities

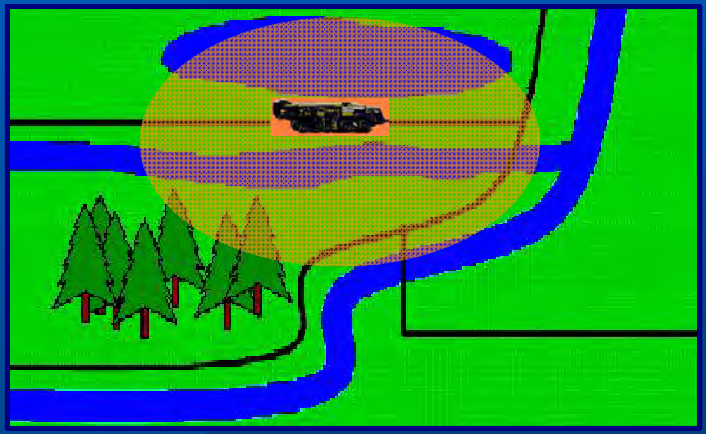
Operating Terrain

Reconnaissance Vehicle Capabilities

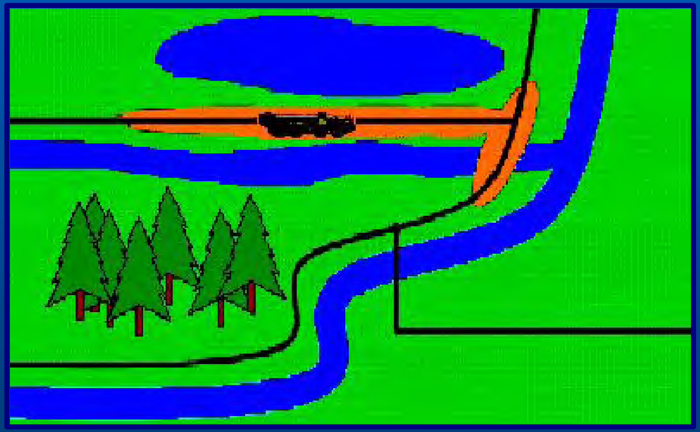
Weapon Capabilities

Approach (Continued)

Search Areas



vs.



Typical AOU

Optimized AOU

Scenario

Using LBTAOU against a mobile, time-critical target:

1. Transporter/Erector/Launcher (TEL) has been identified as a target by UAV
2. Tomahawk (or High Speed Weapon) is targeted
3. A later pass of the UAV indicates the target is no longer present
4. LBTAOU calculates an optimized search region, search route, and loiter area
5. UAV is routed to search the region
6. Tomahawk's current position and fuel status is queried
7. Tomahawk loiters while the target is reacquired
8. Once the target is located, the optimal strike area is selected
9. Weapon is retargeted

Goals

- Identify the AOU for land-based targets as a function of
  - Target Parameters
    - Dimensions, turn radius, max speed, terrain capability, etc.
  - Geographic Features
    - Roads, bridges, landmarks, elevation, terrain, rivers, etc.
- Provide optimized search routes
  - Reduce reacquisition times
- Provide optimal missile loiter position
  - Reduce missile loiter-to-strike time
- Identify target vulnerability windows in environment
- Identify optimal strike locations

Employed Technologies

- Combine mature algorithms, motion analysis techniques, and Geographic Information Systems (GIS)
  - Reduces development time
  - Increases reliability
  - Decreases risk
- Employ GIS Spatial Queries for terrain data access
  - Describes relationship between map locations and geographic features

LBTAOU Terrain Data

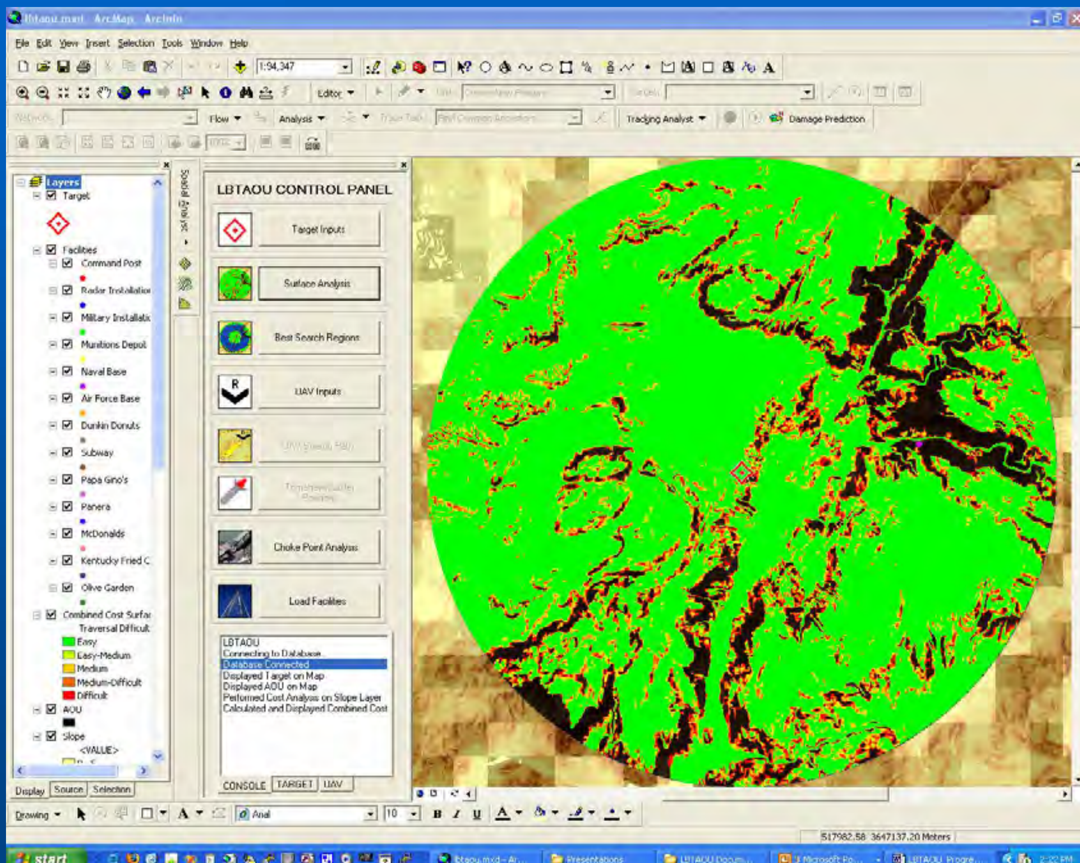
- The LBTAOU prototype currently uses four terrain layers which include:
  - Slope
    - Compared to the max gradient of the targeted vehicle
  - Water Depth
    - Compared to the maximum water depth that the targeted vehicle can traverse
  - Terrain
    - Compared to the ground clearance and terrain capability of the targeted vehicle
  - Forest Density
    - Compared to the width of the land-based target

Current LBTAOU Algorithm Suite

- Combined Cost Surface
- Search Region
- UAV Search Route
- Loiter Position
- Battle Damage Query

Combined Cost Surface

Cost Surface of AOU



The Cost Surface Algorithm will eliminate any region that is unreachable by the target, and rate the difficulty to traverse the land. This region will be given a non-traversable value.

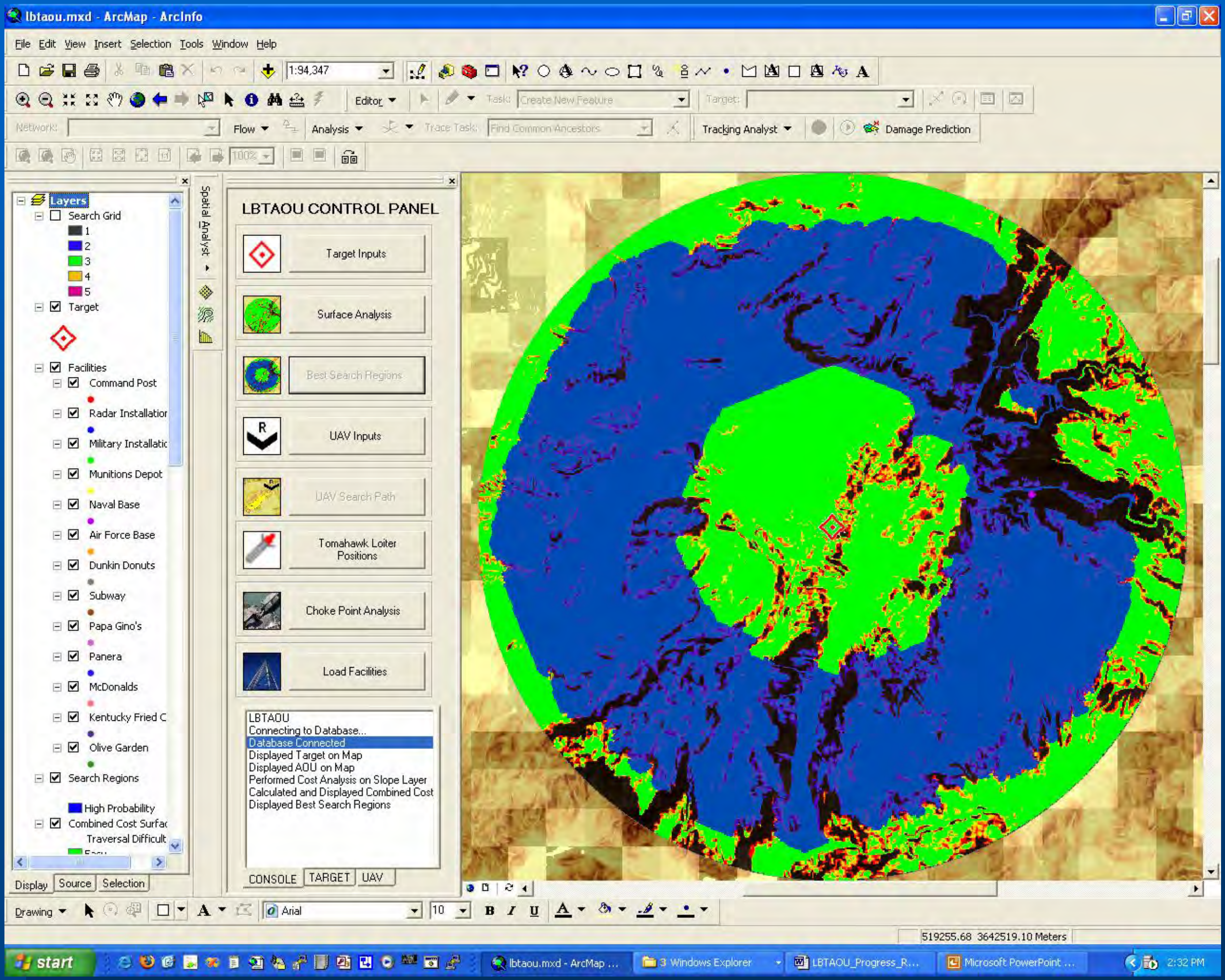
- **Non-traversable**
- **Easy**
- **Easy-Medium**
- **Medium**
- **Medium-Difficult**
- **Difficult**

Search Region

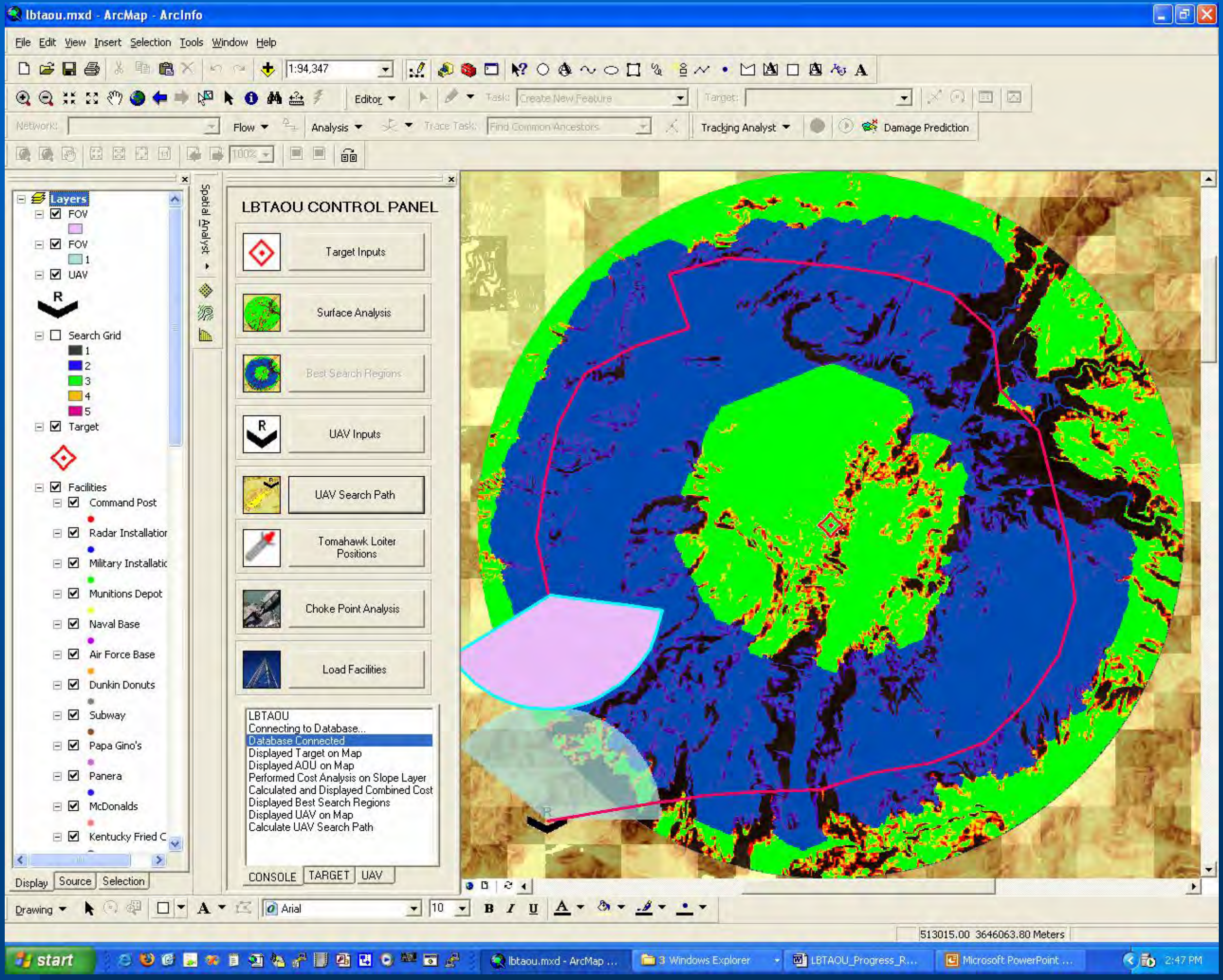
- **Determining the Search Region**
  - **Calculate Cost Distances for land-based target.**
    - Raster containing distance information extending from initial position
  - **Calculate Outer Extent of Search Region:**
    - Cost Distance (meters) <= Radius of AOU (straight line distance)
      - Radius of AOU = (MAX Speed) * (time elapsed)
    - Eliminates areas where target cannot possibly be in the elapsed time.
  - **Calculate Inner extent of Search Region:**
    - Inner extent = INITIAL speed * time elapsed

Search Region

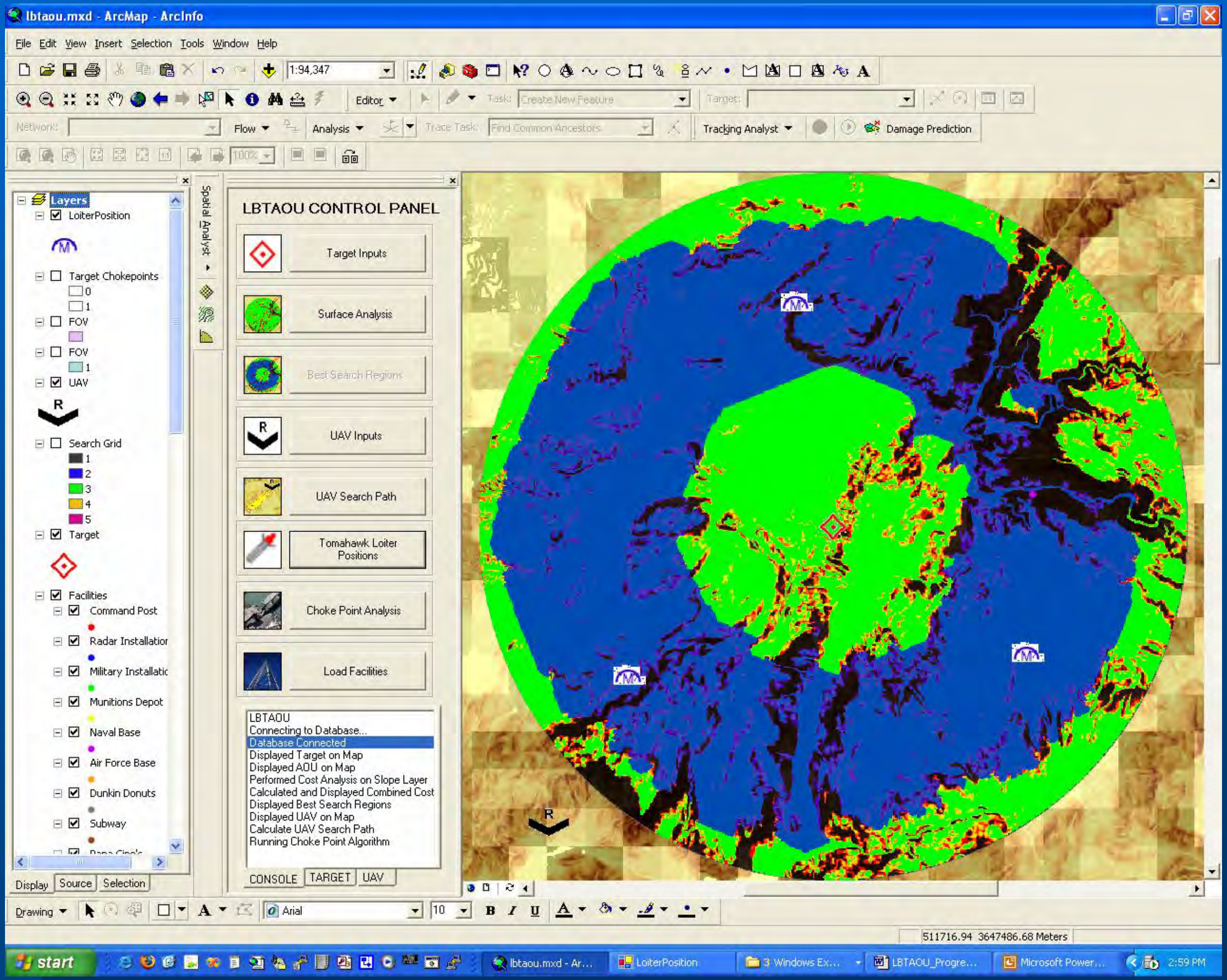
Search Regions Overlay of Combined Cost Surface



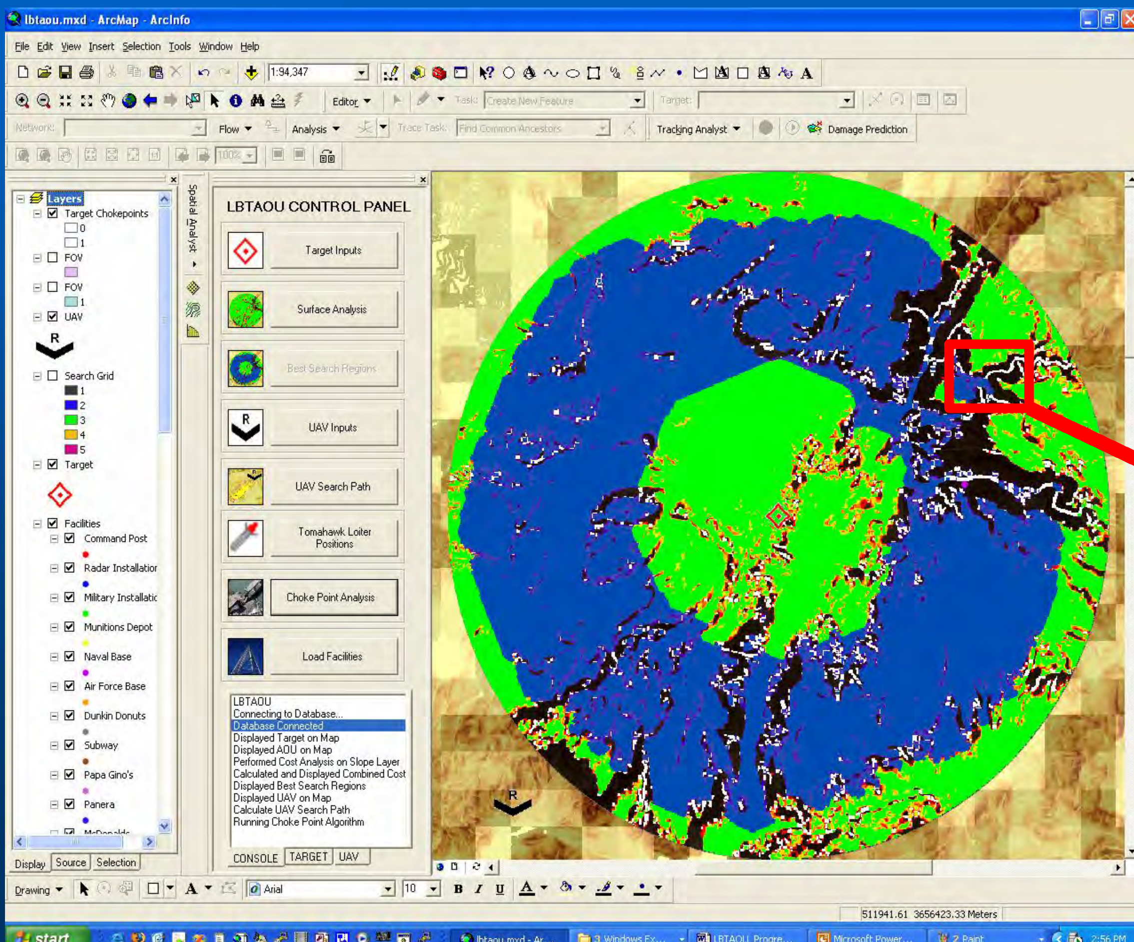
UAV Search Route Example



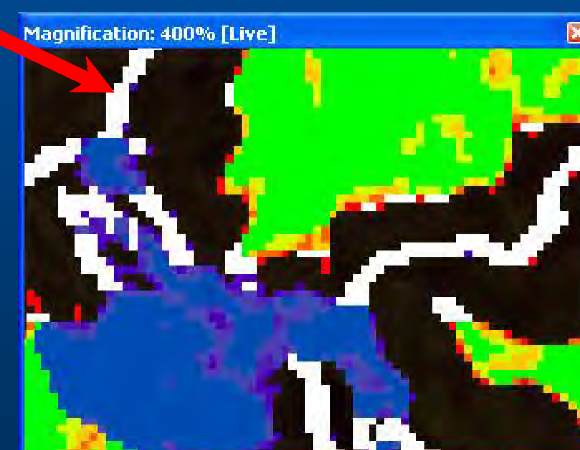
Tomahawk Loiter Position



Choke Point Identification

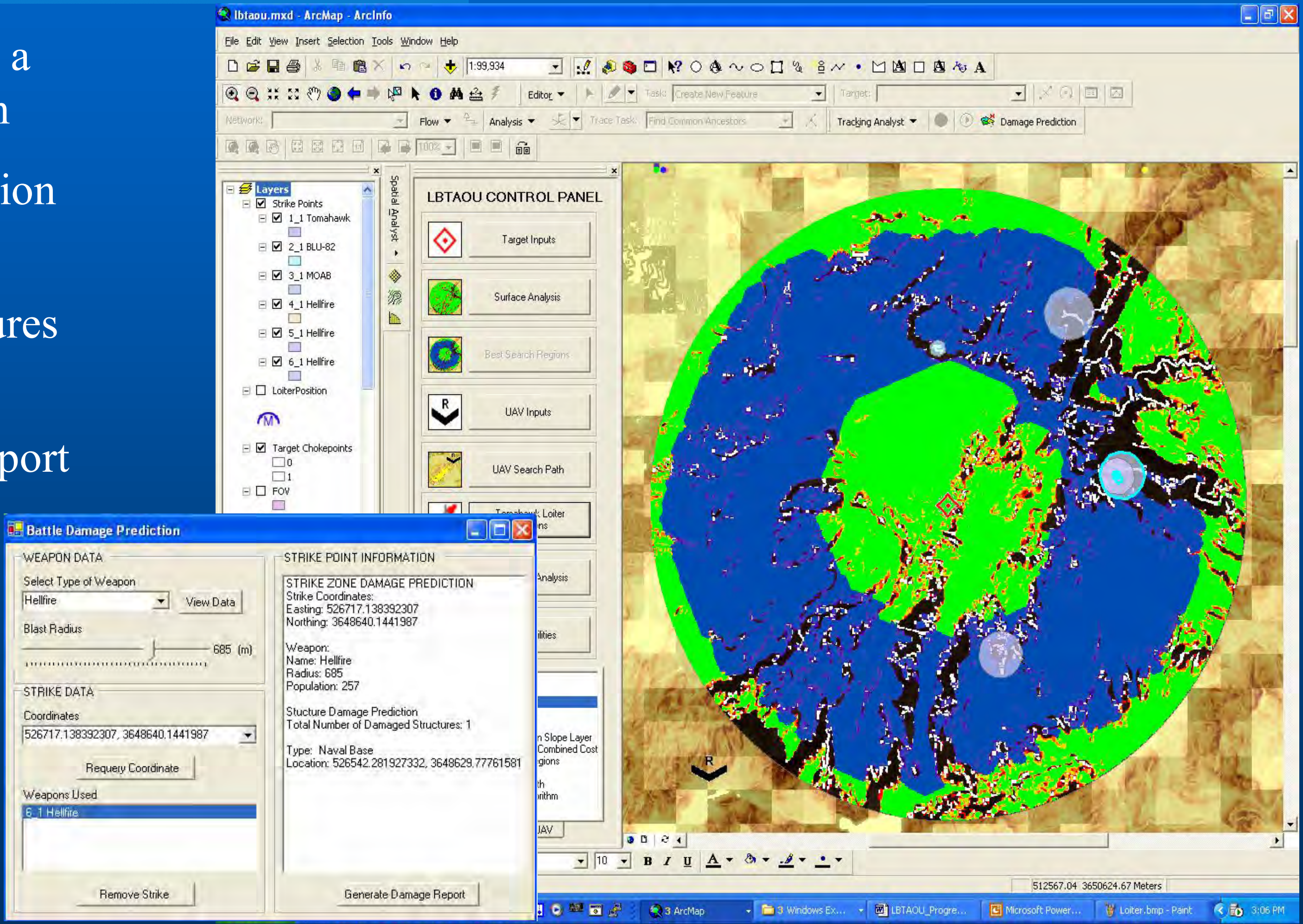


- Determine areas that limited target's ability to evade
- These areas are represented in white



Battle Damage Query

- Graphically displays a strike from a weapon
- Displays the population in the area affected
- Describes the structures in the area affected.
- Generates a Web Report using XML



Future Work

- Investigate application of Fuzzy Logic to GIS spatial analysis
  - Spatial features often do not have clearly defined boundaries, and concepts such as "steep," "close," or "suitable" can better be expressed with degrees of membership to a fuzzy set than with a binary yes/no classification.
- Apply AI to target movement prediction
- Explore Multiple Objective Decision Support
  - Determine best strike coordinates as a function of population and religious sites, within weapon capability restraints
  - Provide target prioritization based on target threat/intent, loitering weapon status, rules of engagement, etc.
- Develop sensor visibility performance models
  - Examine effects of weather on sensor performance
- Develop Command & Control Information Exchange Data Model (C2IEDM) interfaces
  - Supports NATO multilateral data connectivity
  - Supports Sea Trials

Point of Contact

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Countering the Proliferation of Weapons of Mass Destruction

Precision Strike Technology Symposium

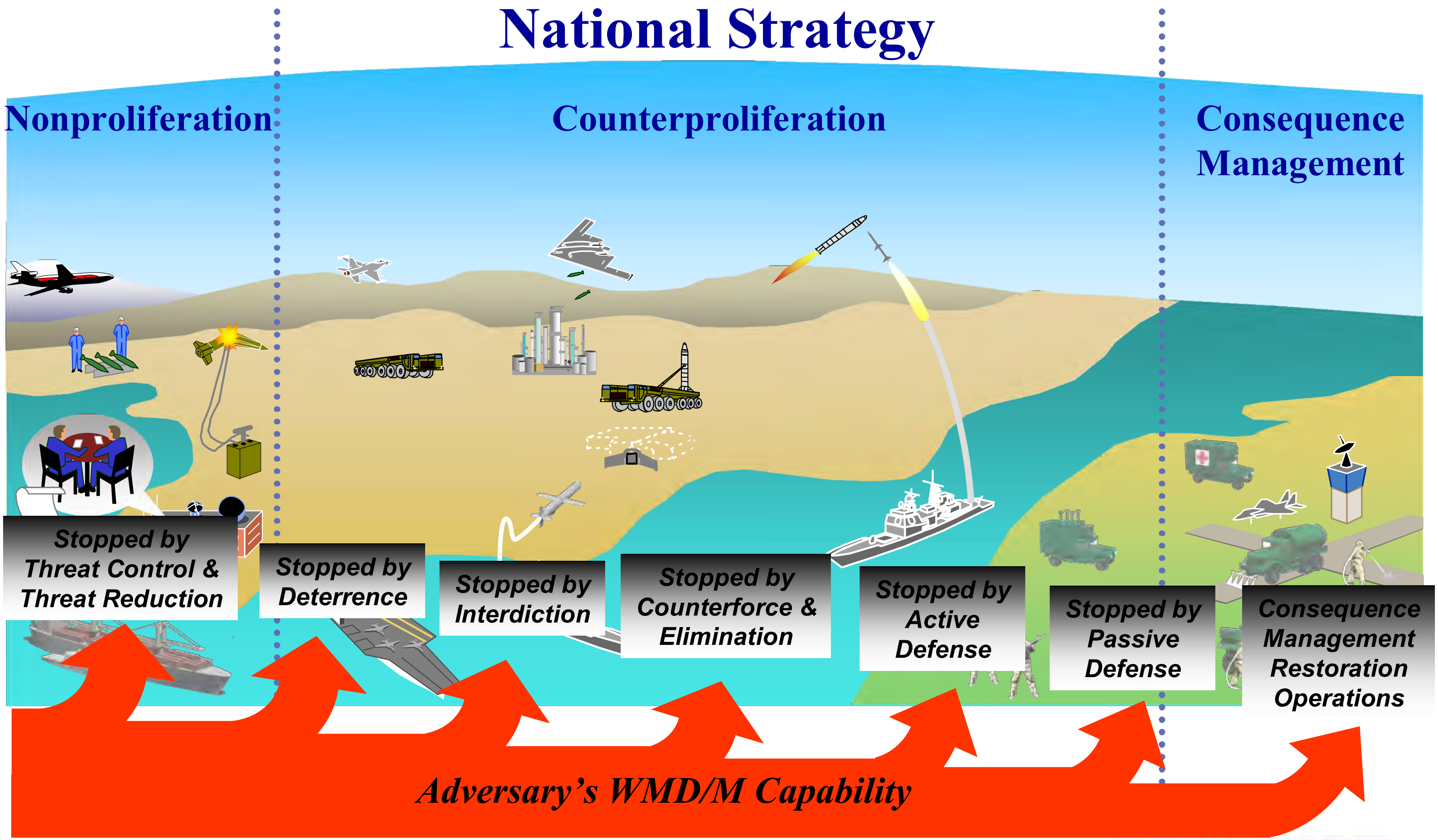
Dr. Jim Tegnelia
Director, Defense Threat Reduction Agency

20 October 2005

Introduction

- Mission Discussion
  - President's National Security Policy
  - Draft JCS Defense Policy
- STRATCOM role
- Defense Threat Reduction Agency (DTRA) role

Layered Defense Approach



The Three Pillars: Nonproliferation

- Treaty verification
- Non-treaty bilateral and multilateral cooperation
- Safeguarding and eliminating former Soviet WMD capabilities
- Proliferation prevention
- Support to U.S. and foreign chemical weapons elimination

Using the full range of diplomatic, economic, informational and military instruments of national power to prevent or limit the acquisition or development of WMD capabilities

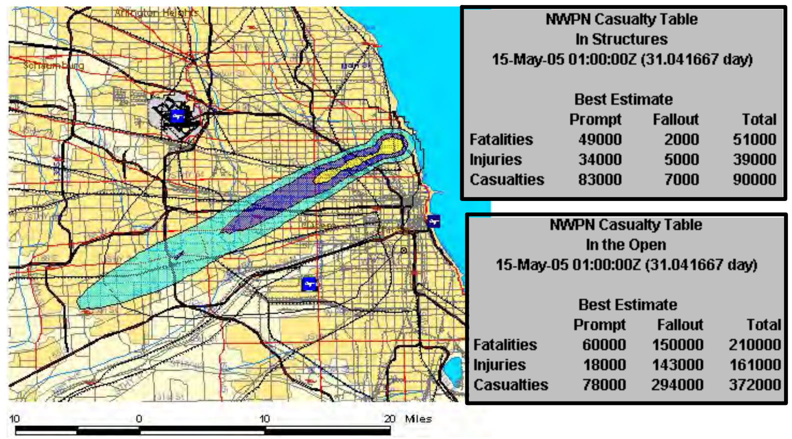
The Three Pillars: Counterproliferation

- Maintain and improve U.S. nuclear deterrent
- Radiation hardening
- WMD agent detection, tracking and defeat
- CBRNE mitigation technologies
- Hard and deeply buried target defeat
- Rapid installation recovery from WMD attacks
- Anti-terror assessments

Using the full range of military activities to deter, identify, deny and counter adversary development, acquisition, possession, proliferation and use of WMD

The Three Pillars: Consequence Management

- Bio prophylaxis
- CBRN decon technologies
- WMD response planning and training
- WMD incident and accident exercise support
- WMD Reachback



NWPN Casualty Table
In Structures
15-May-05 01:00:00Z (31.041667 day)

Best Estimate	Prompt	Fallout	Total
Fatalities	49000	2000	51000
Injuries	34000	5000	39000
Casualties	83000	7000	90000

NWPN Casualty Table
In the Open
15-May-05 01:00:00Z (31.041667 day)

Best Estimate	Prompt	Fallout	Total
Fatalities	60000	150000	210000
Injuries	18000	143000	161000
Casualties	78000	294000	372000

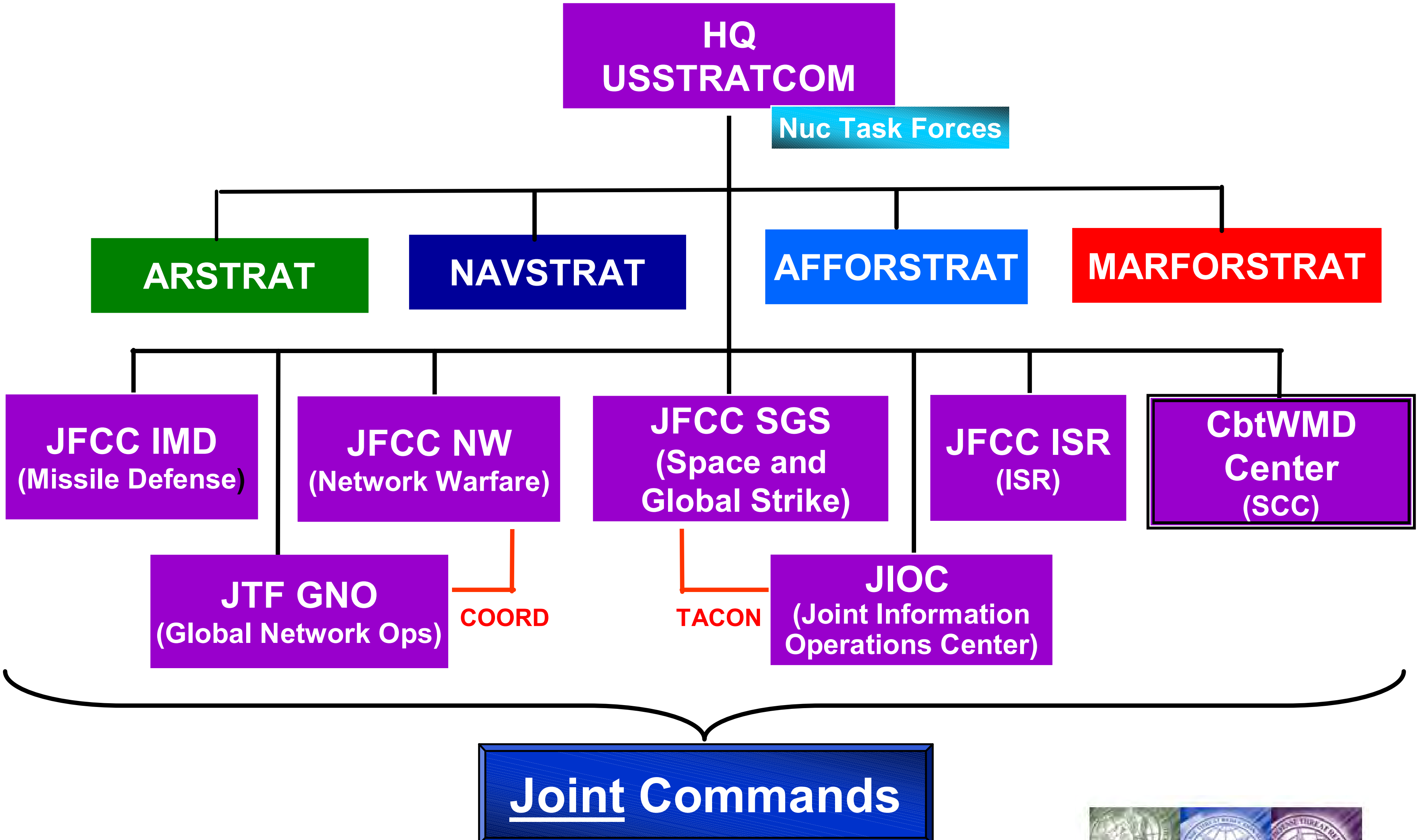
Mitigating the long-term effects of a weapons of mass destruction attack and enabling a rapid recovery

DTRA
Making the World Safer

USSTRATCOM Mission Assignment Guidance

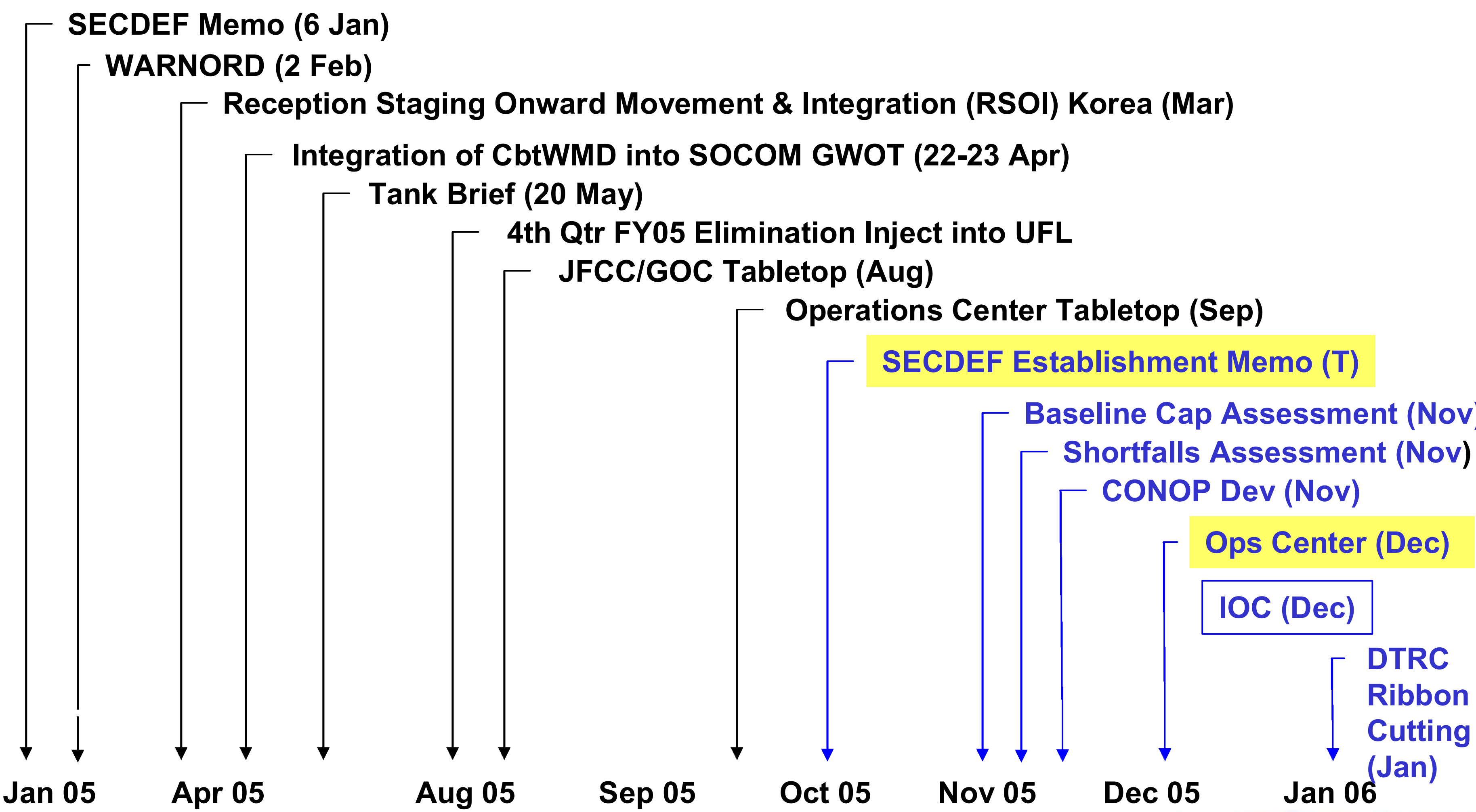
- SECDEF Memo – 6 Jan 05: "I assign CDRUSSTRATCOM as the lead combatant commander for integrating and synchronizing DoD in combating WMD."
- CJCS WARNORD – 2 Feb 05
  - Assess all CbtWMD functions to dissuade, deter, prevent acquisition, transfer or use of WMD
  - Rapidly assess WMD Elimination and WMD Interdiction Capabilities
  - Plan, integrate and synchronize DoD efforts across doctrine, organization, training, materiel, leadership, personnel, and facilities (DOTMLPF) for CbtWMD
- USSTRATCOM Center Establishment Memo – 26 Aug 05
- USSTRATCOM Center Implementation Directive – 26 Aug 05
- SECDEF DIR/DTRA Appointment Memo – PENDING

USSTRATCOM's Component Structure



Making the World Safer

Combating WMD Center Timeline to IOC



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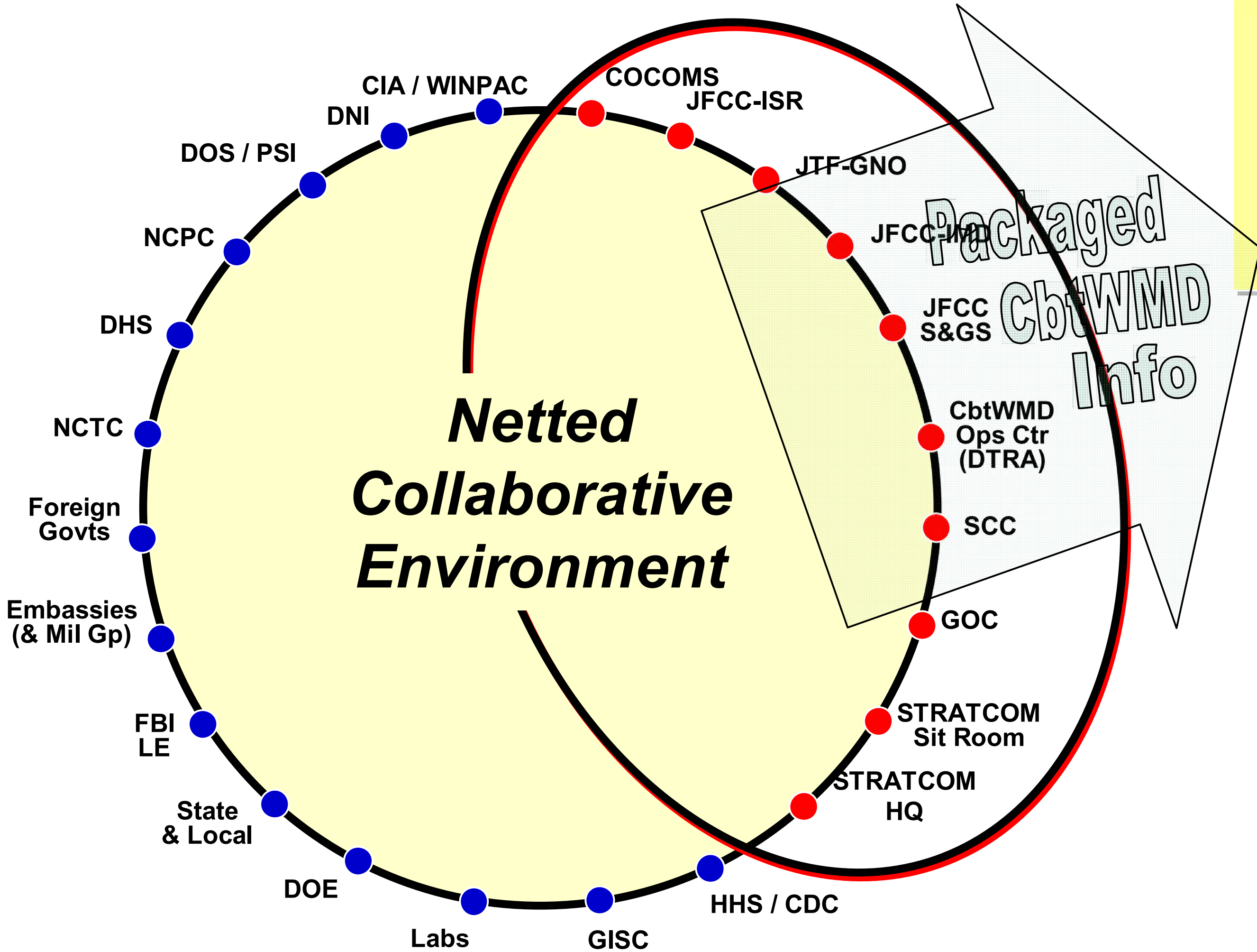
Netted Collaborative Environment



Tailored, global, analyzed CbtWMD COP produces situational awareness

Key enabler for:
- Insights
- Predictive analysis
- COA development
- Informed decisions
- Integration
- Synchronization
- CbtWMD operations support
- Advocacy

RED = IOC
BLUE = FOC

DTRA
Making the World Safer

DTRA Overview

Mission

Safeguard America and its allies from Weapons of Mass Destruction by providing capabilities to reduce, eliminate and counter the threat and mitigate its effects.

Combat Support Role

DTRA's role as a combat support agency is to provide combating WMD and related capabilities to support the Joint Staff and Combatant Commands.

DTRA uses a comprehensive set of tools to combat WMD

Arms Control:

Fulfilling treaty obligations and preventing proliferation

Threat Reduction:

Dismantling the former Soviet nuclear arsenal in place

Technology Development:

Developing, testing and fielding offensive and defensive technologies

Chemical and Biological Defense:

Assuring military operations in hostile environments

Combat Support:

Providing capabilities to counter and defeat WMD, assessing vulnerabilities, and supporting our strategic deterrent

DTRA is organized according to function

Director
Deputy Director

- **Staff Offices**
- **Advanced Systems and Concepts**

Associate Director R & D
Dr. G. Peter Nanos
- Chemical/Biological Technologies
- Nuclear Technologies
- Counterproliferation Technologies
- Systems Engineering Technologies

Combating WMD
Ms. Cathy Montie
Acting

Associate Director Operations
Mr. Mike Evenson
- On-Site Inspection
- Cooperative Threat Reduction
- Combat Support

Associate Director Business
Mr. Myron Kunka

DTRA
Making the World Safer

Recent accomplishments in combating WMD

Nuclear weapons accident exercises (Dingo King 05)

Terrorism vulnerability assessments in Iraq

Biological weapons proliferation prevention

Support to Combatant Commands to develop CBRNE portions of war plans

Tunnel defeat tests

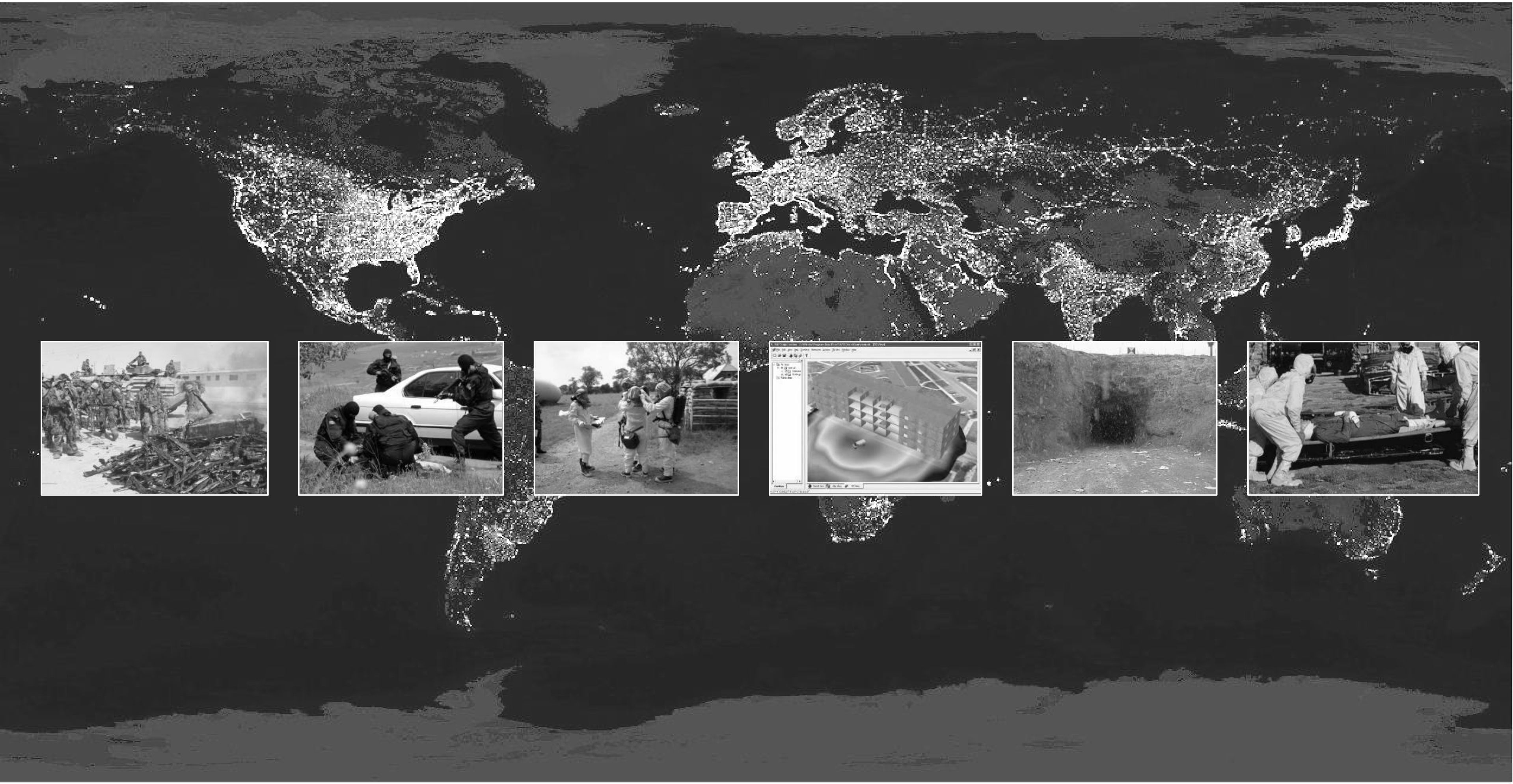
DTRA
Making the World Safer

Conclusions

- Increasing emphasis on combating WMD
- STRATCOM activity is functioning
  - Roles being defined
- DTRA creating a Center of Excellence
  - STRATCOM situational awareness
  - “One Stop” combating WMD activity

DTRA

Making the World Safer...

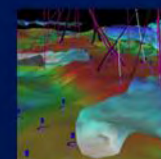


…by combating weapons of mass destruction

Making the World Safer

Mercury Computer Systems, Inc.

Challenges Drive Innovation™

Sensor Data Exploitation

David Toms, Director Business Development

703 963 1591
dtoms@mc.com

Agenda

- **Mercury Introduction**
- **Battlefield challenges**
- **Airborne Reconnaissance Image Exploitation System (ARIES)**
- **Multi-Mission Computing**
- **Cell Processing: A (very) disruptive technology**
- **Questions / Discussion**

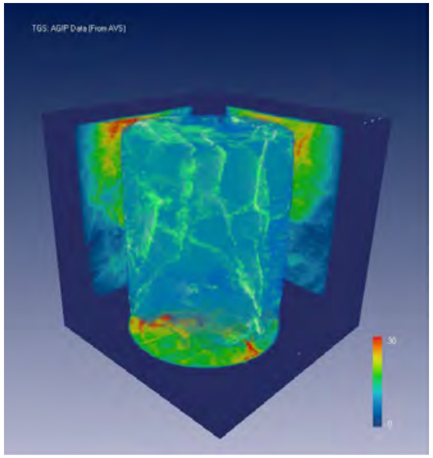
Who We Are

The leading provider of high-performance, scalable, optimized multicomputing solutions for challenging environmental and compute-intensive requirements

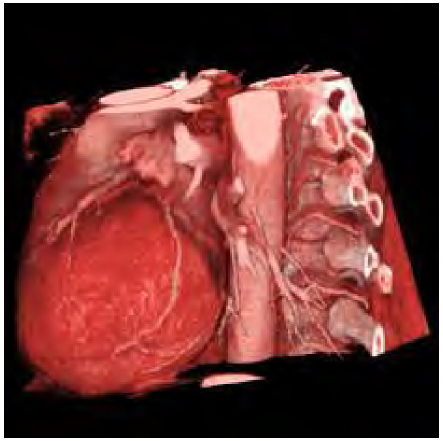
Semi-conductor fab

Defense

3D Seismography



Digital X-ray



Defense Electronics Market

Sensor Processing

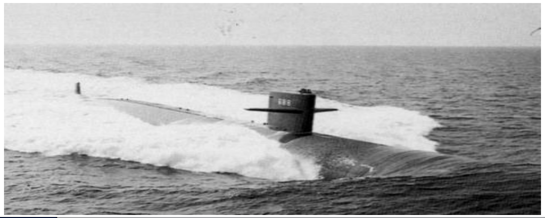
- Radar
- Signals intelligence
- Image intelligence

Across all environments

- Deployed in the air, on the surface, under the water
- Commercial and rugged, air-cooled and conduction-cooled

Full life cycle support

- From R&D through deployment
- Technology insertion in scalable configurations



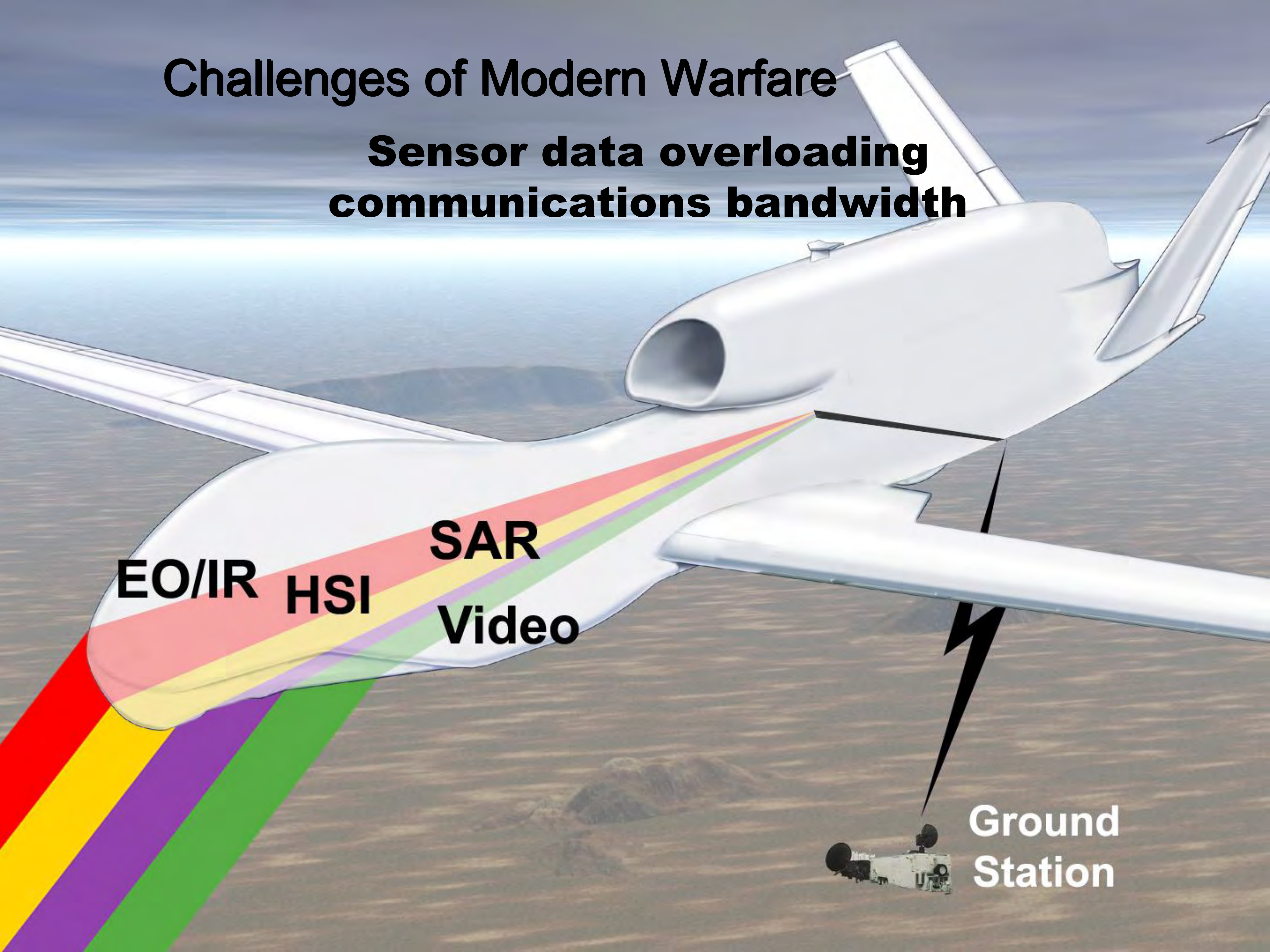
Defense Electronics

Design Wins

Exploitation of Imagery

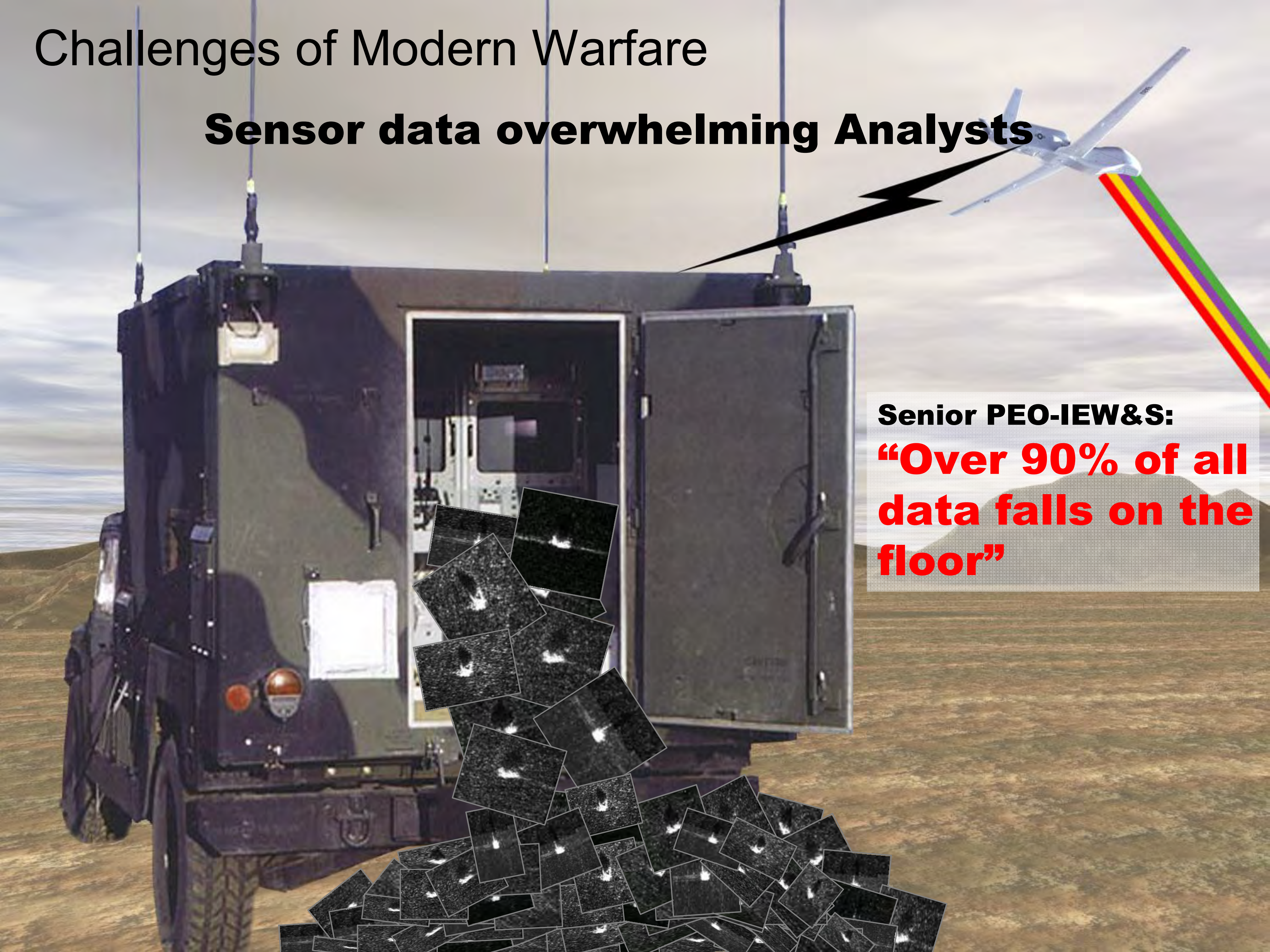
Computer Systems, Inc.
MERCURY
Challenges Drive Innovation™

C4ISR in support of tactical operations is changing quickly – the need now is for rapid (a few minutes) extraction of actionable information from multiple airborne sensors.


Challenges of Modern Warfare
Sensor data overloading
communications bandwidth
SAR
EO/IR
HSI
Video
Ground
Station


Challenges of Modern Warfare
Real Time Access:
Providing real time sensor based intelligence to the shooter on the ground

Challenges of Modern Warfare



Technology Reinforcements

Powering the migration of exploitation from ground to air

Airborne

Reconnaissance

Image

Exploitation

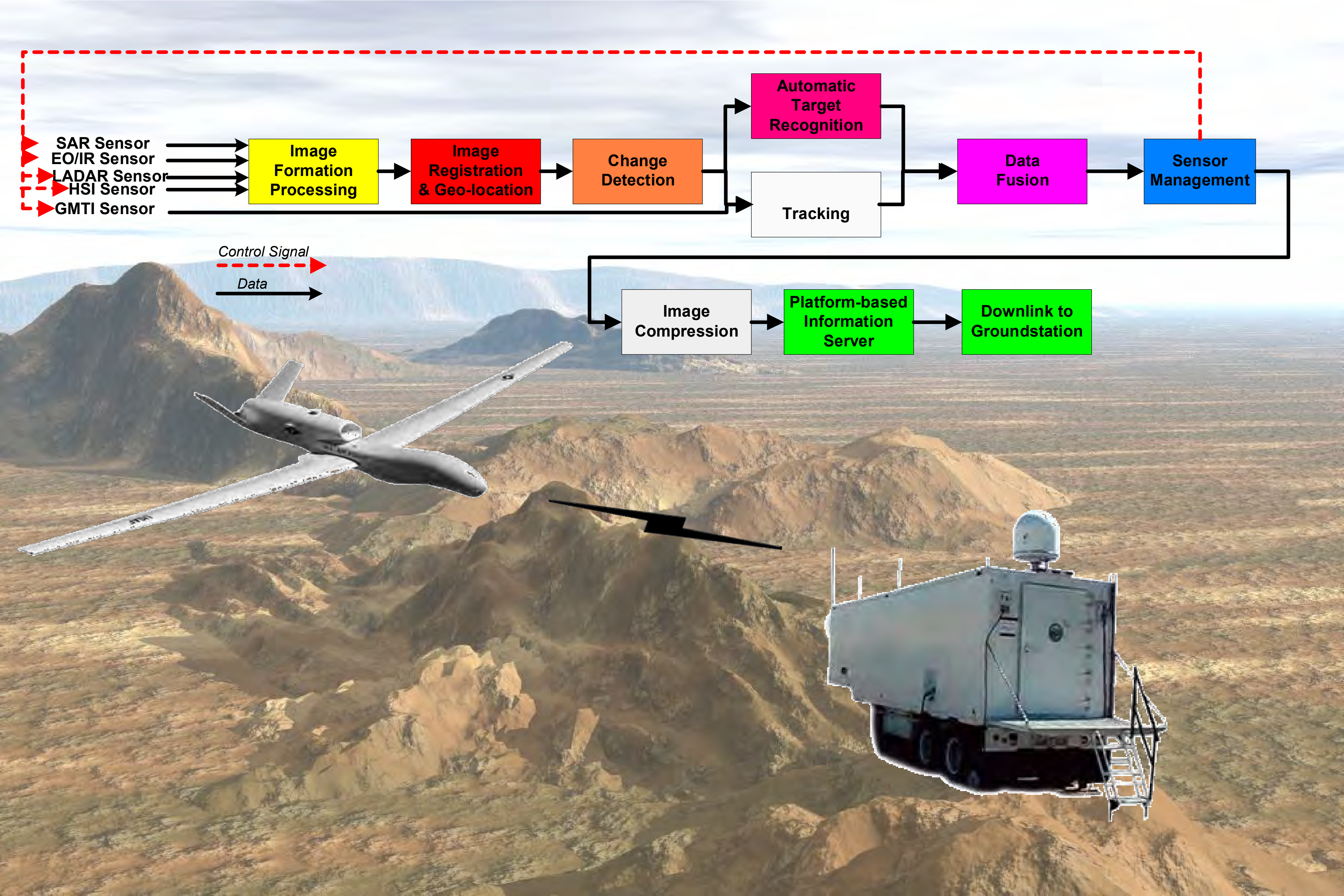
System

As Exploitation migrates from Ground Station to Platform, an IE system will require:

- **High throughput**
  - 200 GFlops, typ
- **Large storage capacity**
  - 1.5 TBytes, typ
- **Optimized SWAP**
- **Multiple outputs**
- **Flexible sensor inputs**
- **Framework for multiple algorithm sourcing**

ARIES

Notional Processing Chain



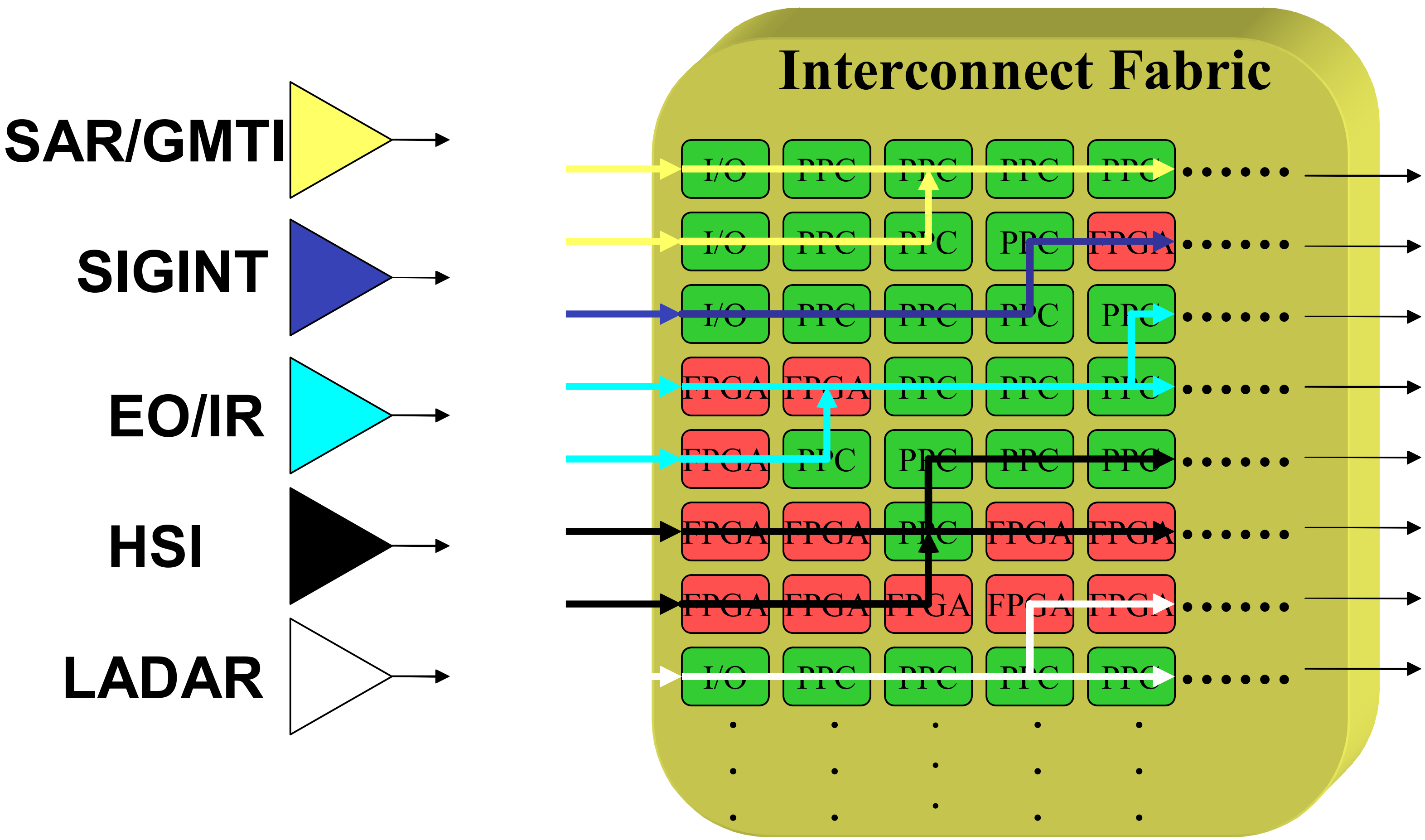
“What if” CONOPS

- **ARIES push - Clipping service – target chips passed down as “bell ringers”**
- **Warfighters’ pull from ARIES**
  - “Look at this location” with EO/IR or SAR
  - “Show me everything from that location over last 24 hours”
  - “Cross cue additional sensor” such as HSI for MASINT
- **View backwards to track point of origin**
- **Transfer data to incoming UAV or other aircraft for mission handoff**
- **“Low Bandwidth” ops should be the goal**
  - Getting the Man out of the Loop

Multimission Computing

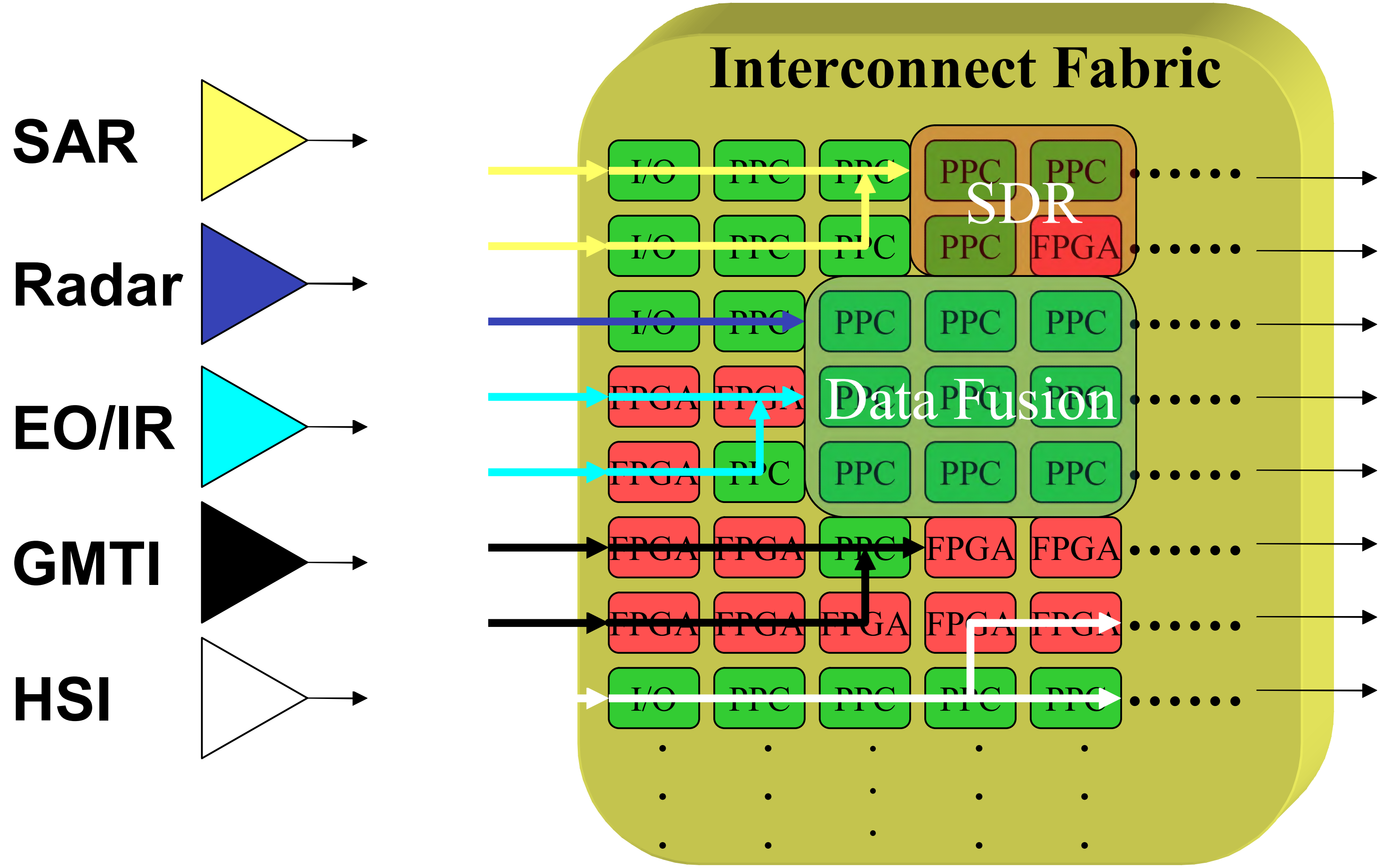
Computer Systems, Inc. MERCURY Challenges Drive Innovation™

Programmable - Scalable - Reconfigurable



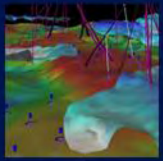
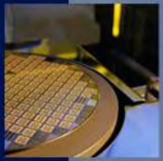
Change Missions on the Fly

- Adapt sensors and processors to new missions



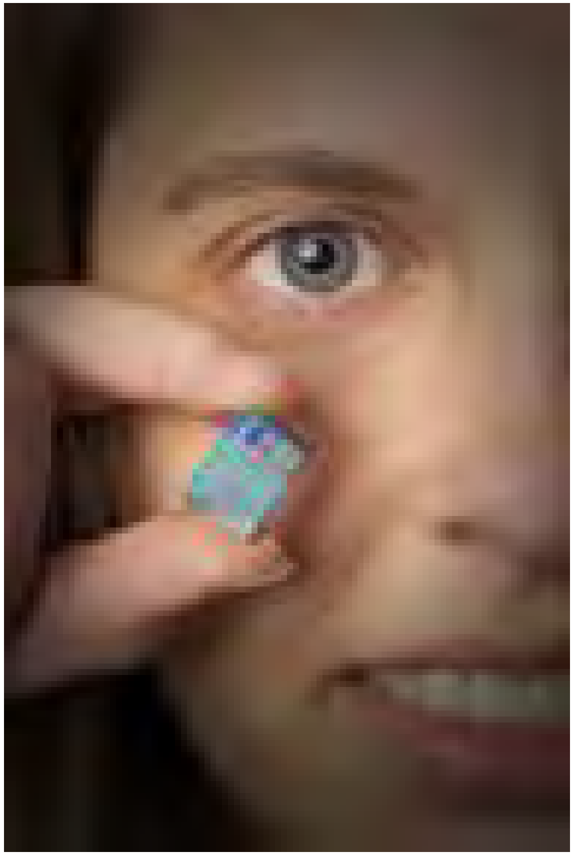
Mercury Computer Systems, Inc.

Challenges Drive Innovation™

Cell: A (very) disruptive technology

Mercury's Relationship with IBM



In June 2005, Mercury announced a strategic alliance agreement with IBM offering Mercury special access to IBM expertise including the broadly publicized Cell technology.

Multicomputer-on-a-chip

How Is This Relationship Working?

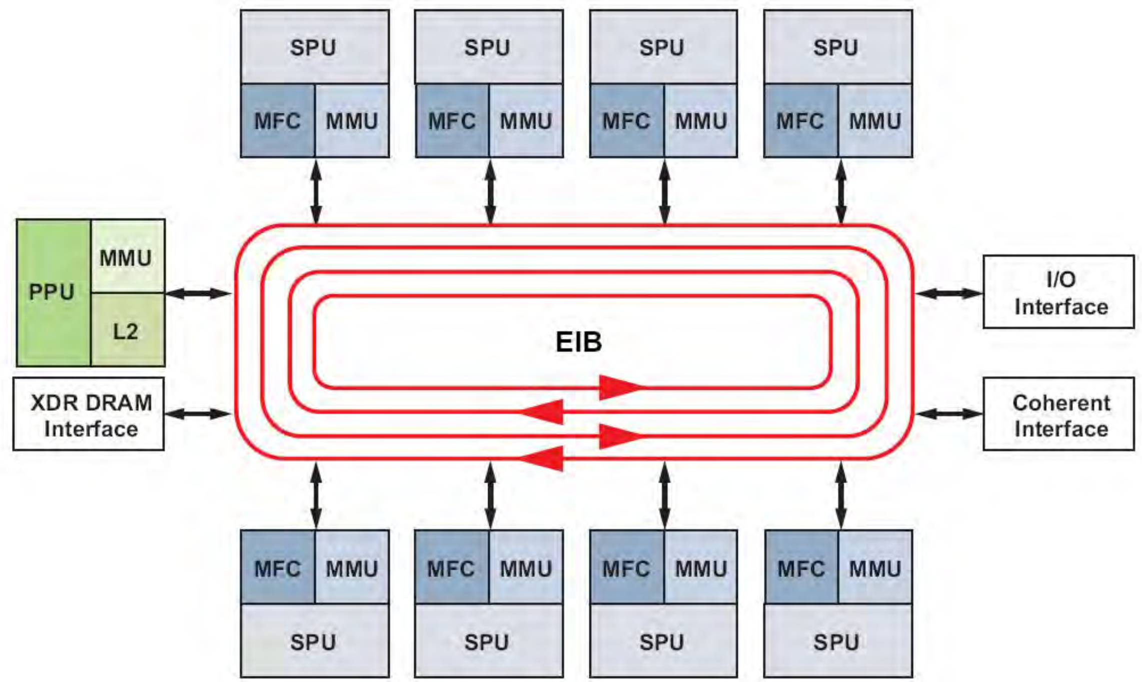
Mercury CEO Jay Bertelli and IBM's Engineering and Technology Services GM Dr. Satish Gupta shake hands following signing of historic alliance between the two companies.

- **IBM Engineering and Technology Services approached Mercury in the second half of 2004**
- **IBM E&TS is a services-oriented organization that is highly complementary to Mercury's customer-focused product organization**
- **IBM and Mercury engineering teams are collaborating on design of Cell-based products**
- **Work has been underway on design of initial products for many months**

Cell Processor Roadmap

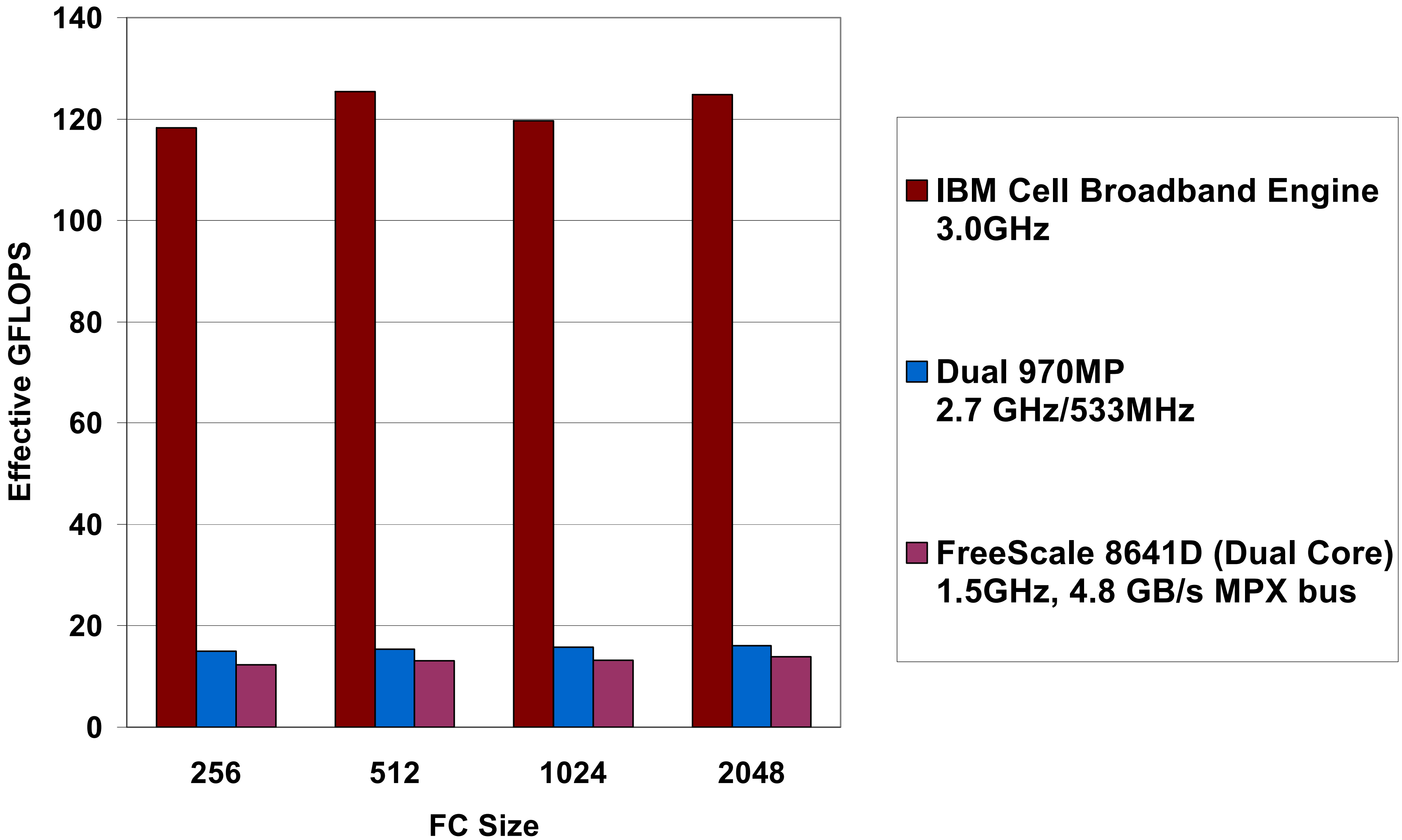
- **Architecture and frequency improvements driven by game consoles**
  - PS One launched in Japan in December 1994
  - PS2 launched in Japan in March 2000, about 5 years later.
  - PS3 unveiled on May 16, 2005. It will launch "Spring 2006", about 6 years later.
- **Process shrinks likely (to reduce manufacturing cost) within the lifetime of a single console**
  - Should improve power characteristics
  - May allow sorting for chips yielding at modestly higher frequencies.

Cell BE Processor Block Diagram



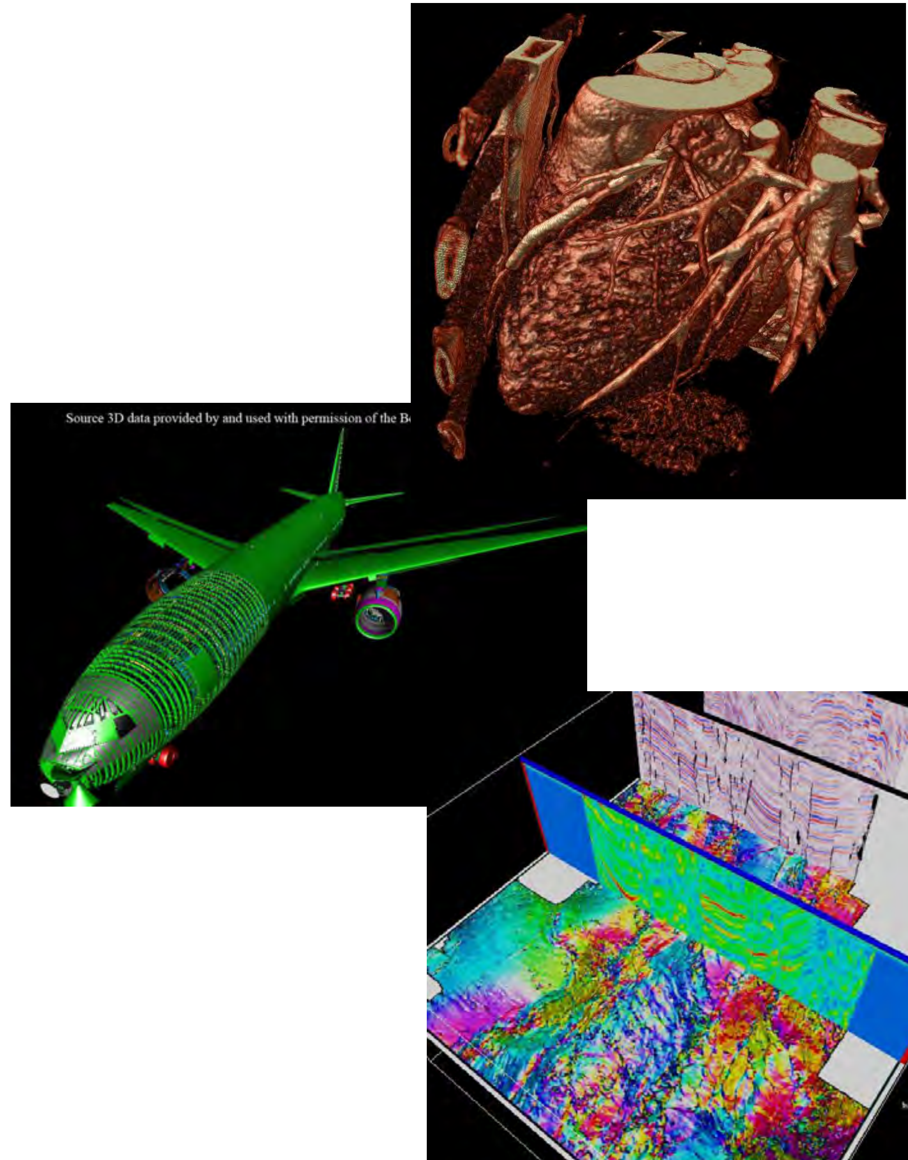
- **Cell BE processor boasts nine processors on a single die**
  - 1 Power® processor
  - 8 vector processors
- **A high-speed data ring connects everything**
  - 192 GB/s maximum sustained bandwidth @ 3Ghz
- **Flexible IO**
  - Up to 60 GB/s
- **Multicomputer on a single chip**

Fast Convolution – Absolute Performance



Likely Applications

- We are actively engaged with customers on Cell technology in these industries:
  - Medical imaging, both traditional 2D and real-time 3D
  - Semiconductor inspection
  - Visualization & simulation
  - Seismic
  - Defense
  - Telecommunications



Summary

- **Image Exploitation appears to be on the threshold of undergoing a sea change.**
- **Technology is here today which can greatly improve the way we operate**
  - New high performance computers with large storage
  - New algorithms to support Image Exploitation
- **Image exploitation is being driven from ground stations to sensor platforms**
- **Cell technology offers order-of-magnitude improvement in performance per processor**
  - Significant improvement in performance per Watt

Raytheon
Customer Success Is Our Mission

PRECISION ENGAGEMENT

Raytheon

Accelerating Networked Sensors & Fires

October 19, 2005

Precision Engagement Strategic Business Area

Providing the Warfighter timely, effective and affordable Mission Solutions that span the breadth and depth of the Battlespace

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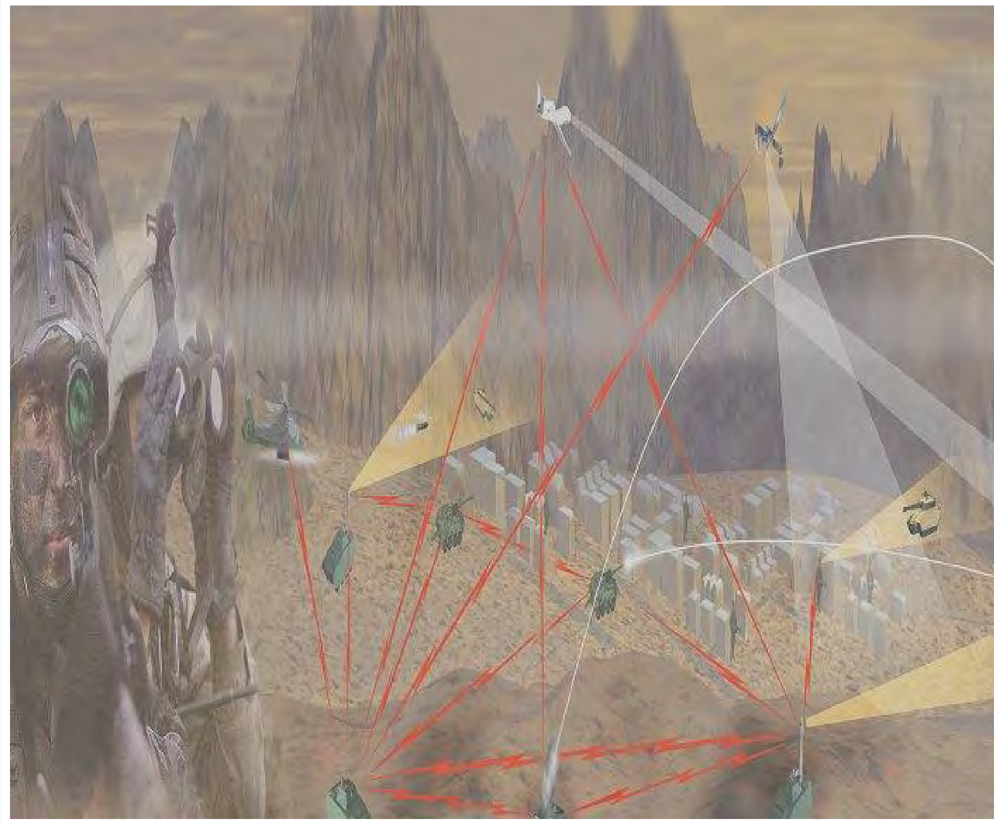
Director, PE SBA
John_P_Weinzettle@Raytheon.com
520.794.4079



Raytheon

A Perspective on Networked Sensors & Fires

- The U.S. Military is implementing an operational concept where early-entry & light forces rely on ***precision strike*** to augment the lethality previously associated with heavy, direct-fire weapons

- Effective Precision Strike Requires:
  - Precise Targeting Sensors
  - Precision Munitions
  - Digital C4I (includes datalinks)
  - New/revised tactics, techniques and procedures

- Must Think in System Terms

FOCUS IS AT MODULAR BRIGADE COMBAT TEAM (BCT)

The Changing Nature of Warfare

- Battlefield being replaced by Battlespace
  - 360 degree operations
  - 3 Block War
  - Urban/Complex terrain
- Different levels of war collapsing- strategic=operational=tactical
  - Rules of Engagement (ROE)
  - Collateral Damage
- Capability becoming more important than platforms
- Joint – How We Plan & Fight
- Changing Targeting Environment
  - Fixed targets becoming more mobile; mobile targets more fleeting
  - Targets more time sensitive

Raytheon

Networked Fires Process – What's being Worked

Sensor System

- Target Detection
- Location
- Reduced TLE
- Integrate sensors into network
- BDA

Weapons System

- Develop multi-mode seekers
- Develop reliable ATA / ATR
- Improve IMU / INS / GPS systems to reduce delivery error
- Integrate platform / munitions into Network
- Develop more effective lethal mechanisms
- Improve propulsion reducing TOF

Network System

- Integrate communications
- Develop reliable / robust platforms
- Develop effective Battle Management System software
- Manage the Spectrum (manage / expand available bandwidth)
- Develop reliable long-range radios

Operational / User Community

- Articulate requirements
- Develop appropriate TTP
- Staff / train Battle Command cells appropriately

FROM A SYSTEMS VIEW DO WE NEED TO OPTIMIZE ALL AREAS?

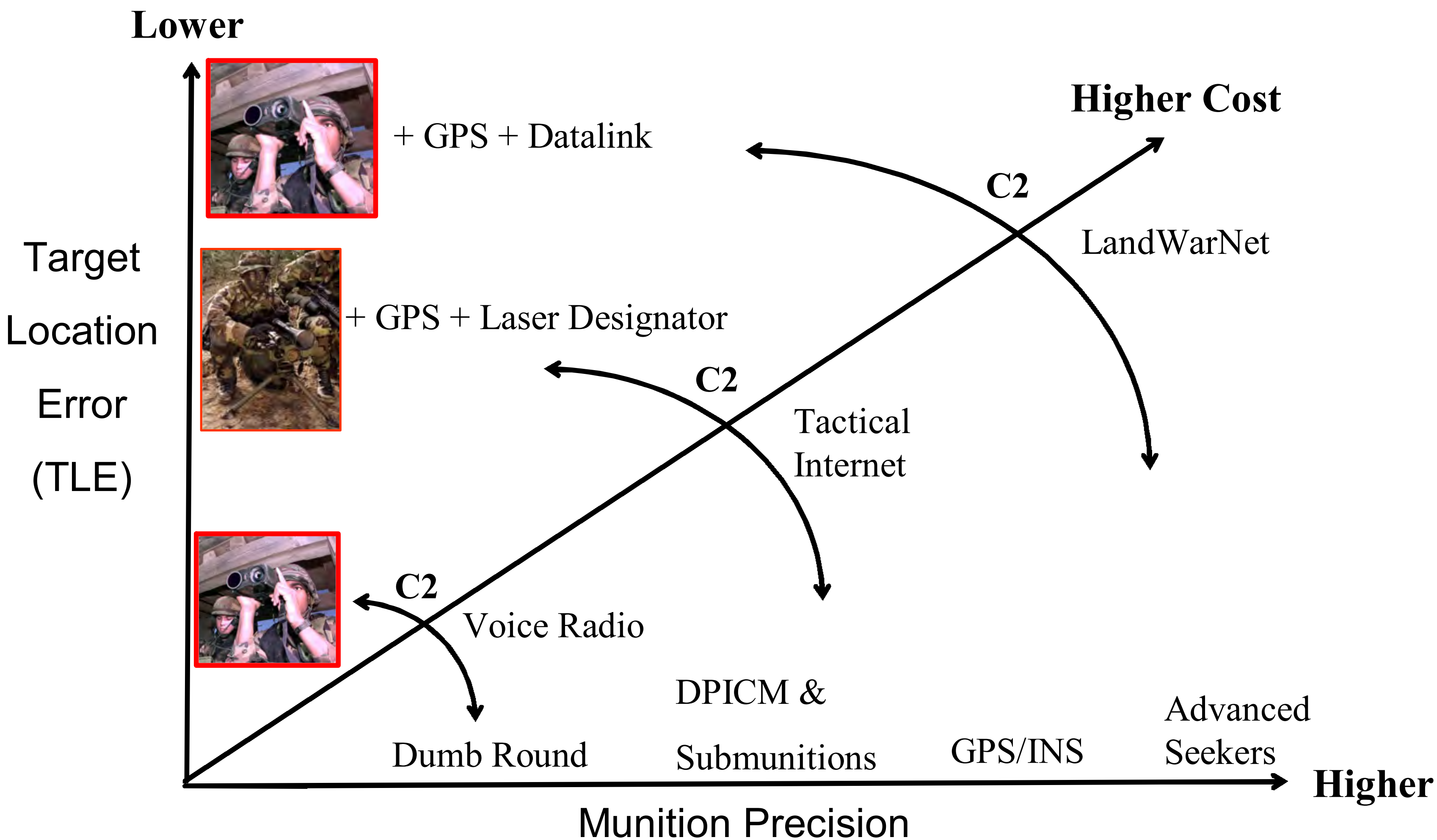
Top Challenges to Accelerating Networked Sensors & Fires

Raytheon

1. **Human Intervention Points**
   – Trade off between C2 and responsive fires
   – Decision mode algorithm (TTP)
2. **Line-of-Sight Transport Capability Limitations**
   – Network transport capabilities provided by waveforms – the "tools in the toolbox"
   – Need to integrate these "tools" to form the network – one tool doesn't fit all needs
3. **Functionality and Interoperability**
   – USMTF - LINK-16 - JVMF - AFATDS - Blue Force Tracking ….
4. **Precision Engagement Limitations** – *Target Location Error (TLE)*
5. **Cold War Tactics, Techniques, Procedures (TTP)**

Raytheon

Ending the Era of Uncertainty?



IS IT AFFORDABLE?

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Affordability – What is the Right Metric?

EXAMPLE – "The Building Way"

Tank type target

	Msl	Round
TLE (m)	100	100
CEP (m)	.5	35
Rounds/hit	1	40
Cost/Round	$100K	$1K
Cost/Hit	$100K	$40K

Building Assessment: Precision $60K higher -- not affordable

EXAMPLE – A Bigger Picture

Tank type target

	Msl	Round
TLE (m)	100	100
CEP (m)	.5	35
Rounds/hit	1	40
Cost/Round	$100K	$1K
Cost/Hit	$100K	$40K
Training Rounds / Hit	0	160
Training Rds Cost **Training O&S $**	0 $	$160K $$$
Total Cost / Hit	$100K	$160K

Alternative Assessment: Precision saves $60K + $$ -- Precision affordable

SUMMARY

- Must think in system terms to resolve fact sensors and shooters are in different stages of evolution

- Sufficient capabilities exist today to build a seamless Brigade Combat Team holistic network – "THE TOOLS ARE AVAILABLE"

- Need to relook division of labor between – sensors, weapons, the network and operational/user community

- Time to relook fires process – review from the bottom up vice the top-down

Weapon Systems & Technology Directorate

Change in view point: Application of the Dual Recoil System to Light Weight Towed Artillery

William T. Zepp

Providing America Advanced Armaments for Peace and War

ARDEC

Precision Strike Technology Symposium
19 October 2005

Role of Artillery

- Support maneuver elements
  – Provide timely, accurate and effective fires
  – Both in direct and general support
- Tube artillery has a place with rocket/missile and mortar systems
  – Range capability
  – Accuracy
  – Responsiveness

System Limiting Factors

- Strategic Mobility
  - Limited assets
  - Competition for space
- Tactical Mobility
  - C-130
  - Helicopter performance
  - Prime mover performance

Current Light Cannon Artillery M119A2 105mm Towed Howitzer

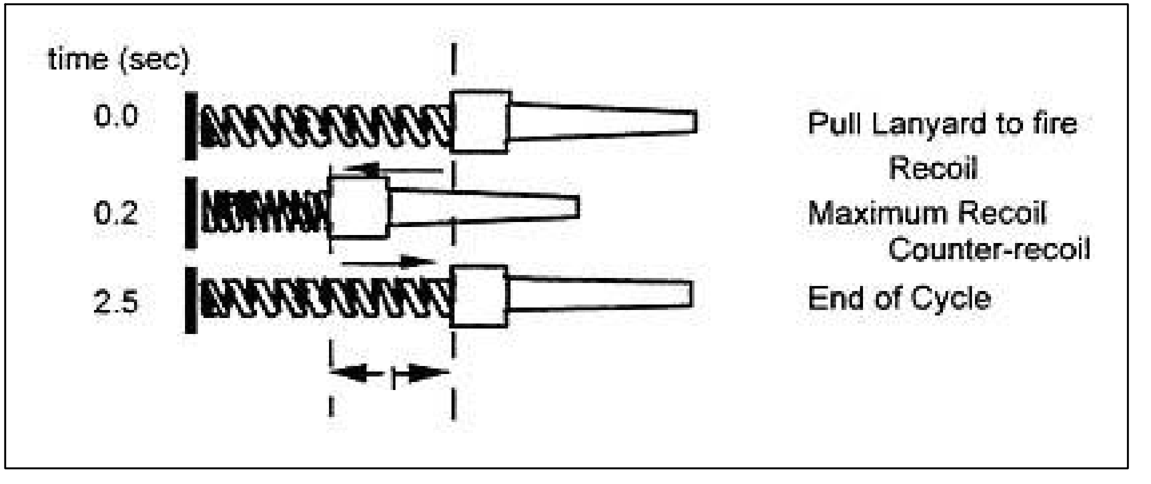
- Max Range/Precision (M913)
  - 19.5 km / 32 m CEP
  - 20 km / 35 m CEP (Battlefield Emergency)
- Weight - 4270 lb
- Prime Mover – M1097 HMMWV

Weapon Weight Reduction

- Limited by recoil reaction
- Recoil reaction reduction dependant upon system utilized
- Structural Life

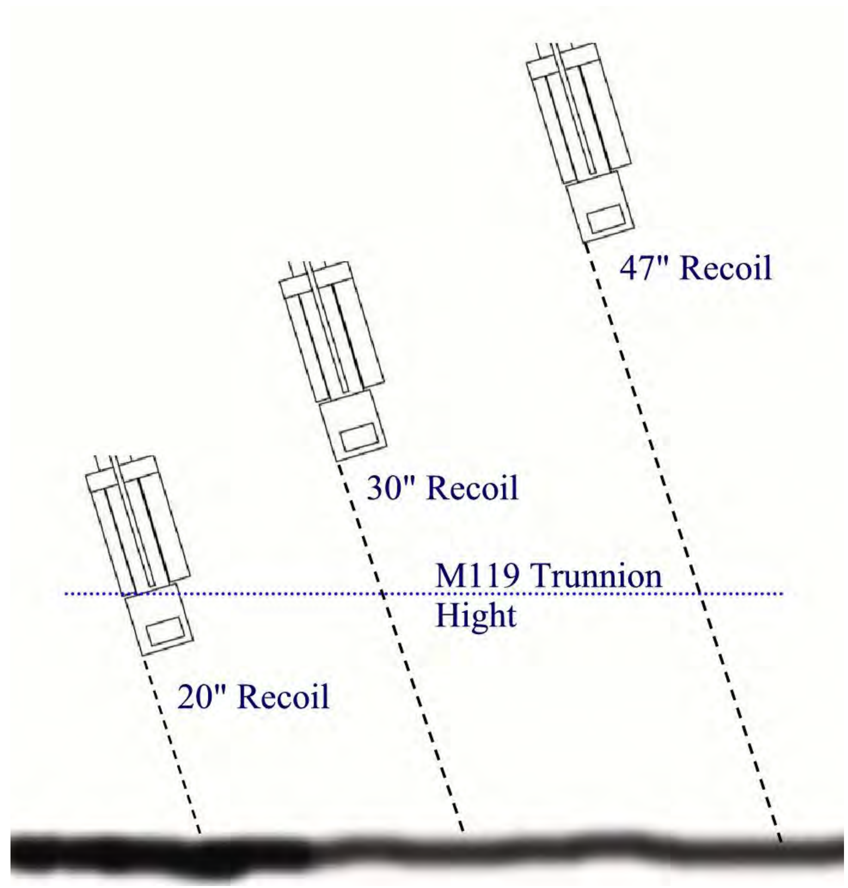
Fire-In-Battery
Single Recoil System

For a given weapon impulse and recoiling mass, the weapon load is inversely proportional to the recoiling mass and the distance it is allowed to translate.

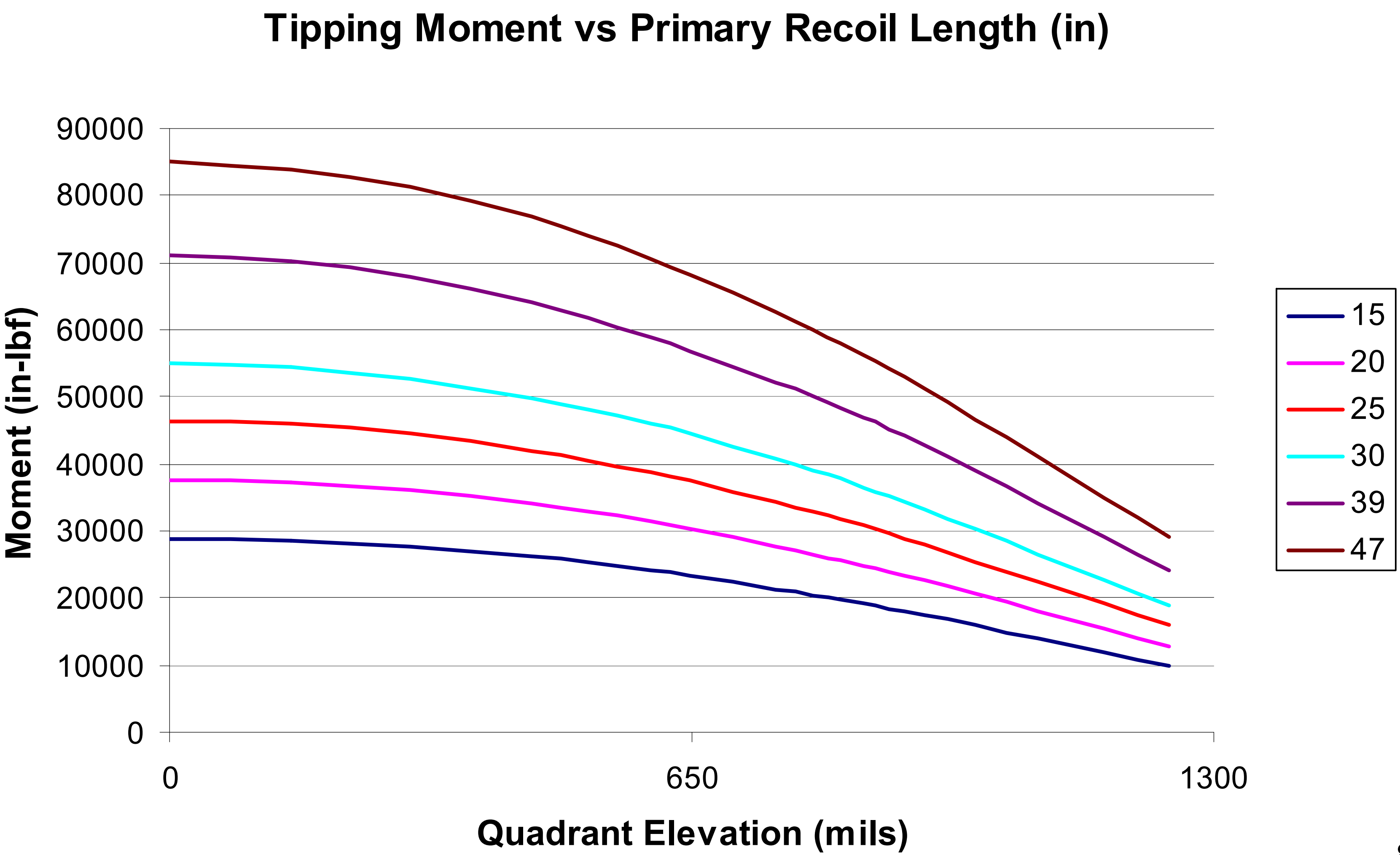


Implications of Increasing Recoil Distance

- Tipping center of gravity shifts
- Recoil mechanism and cradle structure increases
- Loading more difficult complicated
- Recoil cycle time impacted

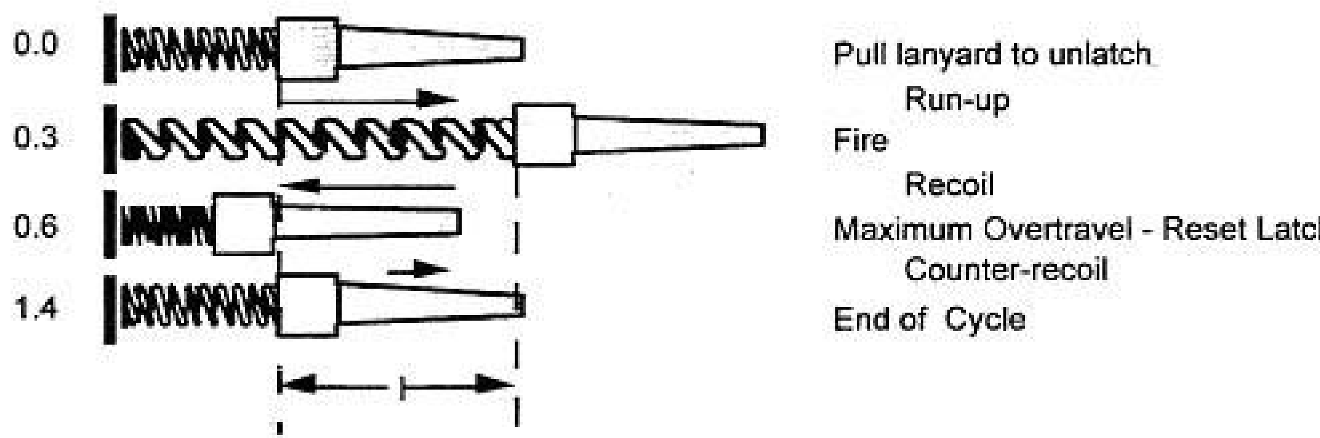


Implications of Increasing Recoil Distance



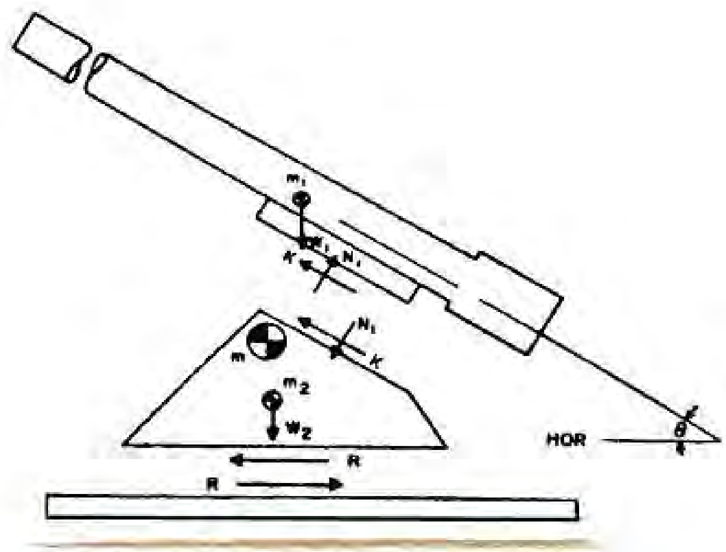
Fire-Out-of-Battery Single Recoil System

- Recoil impulse partially countered by inducing forward momentum prior to weapon firing
- Performance affected by temperature, forward velocity, and position along orifice control



Fire-In-Battery
Dual Recoil System

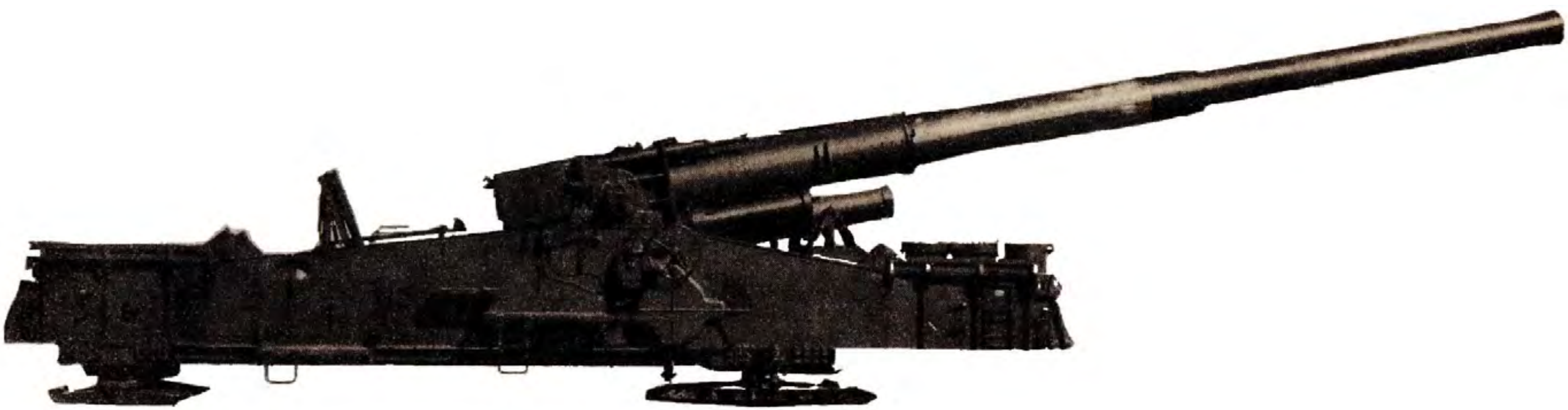
Recoil system between cannon and cradle and recoil mechanism between the top and bottom carriages



Dual Recoil Historical Application

- Very heavy artillery systems from World War I into the 1950’s
  - Railway guns
  - Very heavy mobile siege guns and howitzers
- Dual recoil system required to handle:
  - Huge recoil forces (projectile weights/ranges)
  - Within reasonable physical and logistic limits

US M59 280mm Towed Gun



System Weight – 47 tons

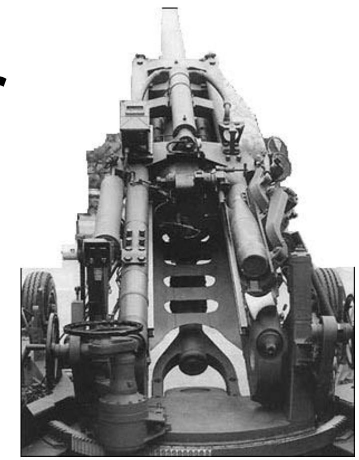
Projectile Weight – 550 lb.

Charge Weight – 150 lb.

Range – 27 km

Recent Weight Reduction Efforts Towed Cannon Artillery

- M777 155mm Towed Howitzer
  - Increased recoil length of single recoil FIB
  - Titanium

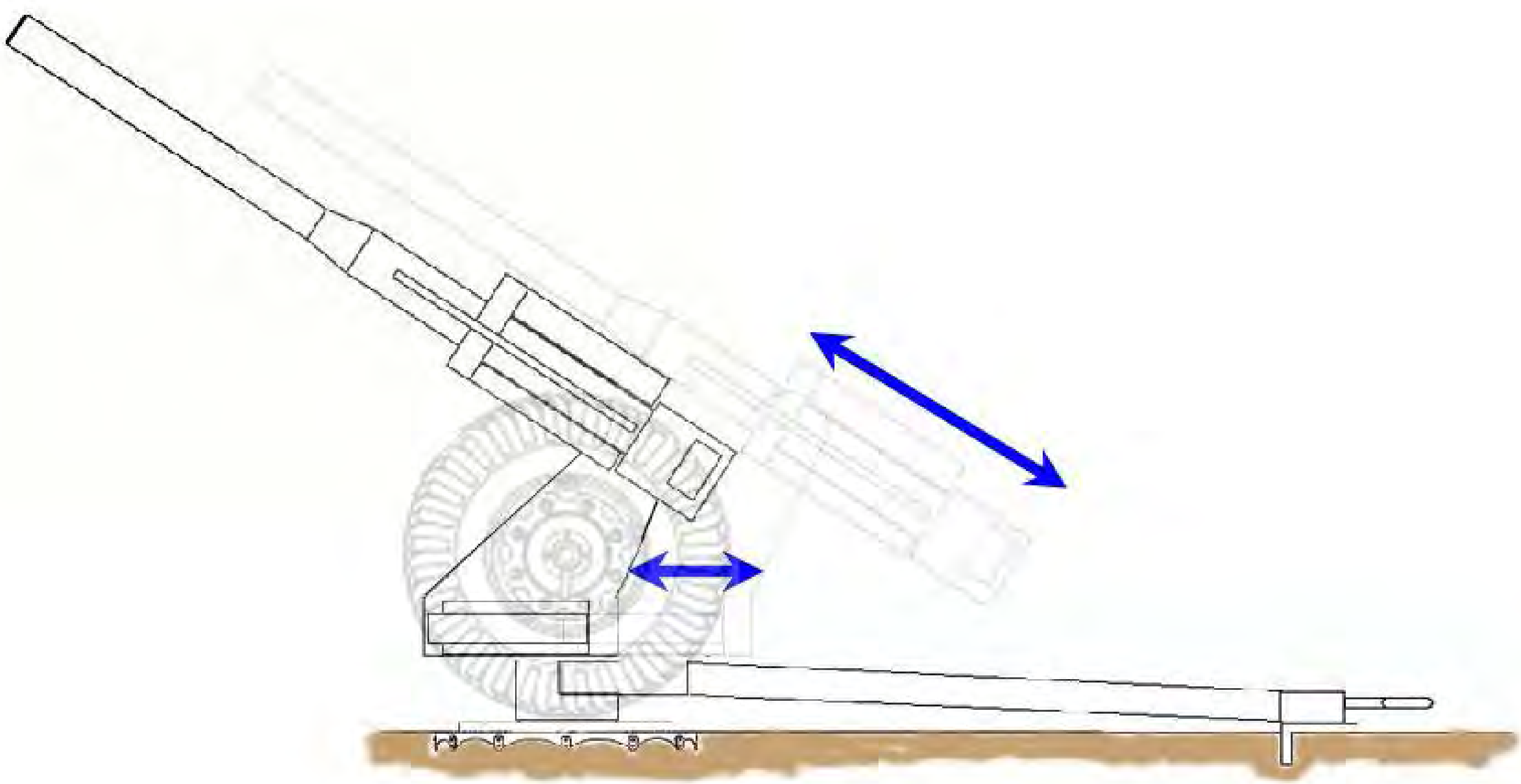


- Giat LG1 Mk II 105mm Towed Howitzer

Draft Requirements for Forcible Entry Weapon (FEW)

Criterion	Threshold	Objective
Weight	3,300 lbs	3,000 lbs
Max. Range	19.5 km with M913	20 km with CCF/BB 21 km without CCF
Rate-of-Fire	8	10
Shift Fire Azimuth	6400 mils	6400 mils
Emplacement/Displacement	60 sec.	30 sec.

Concept System Utilizing Dual Recoil System



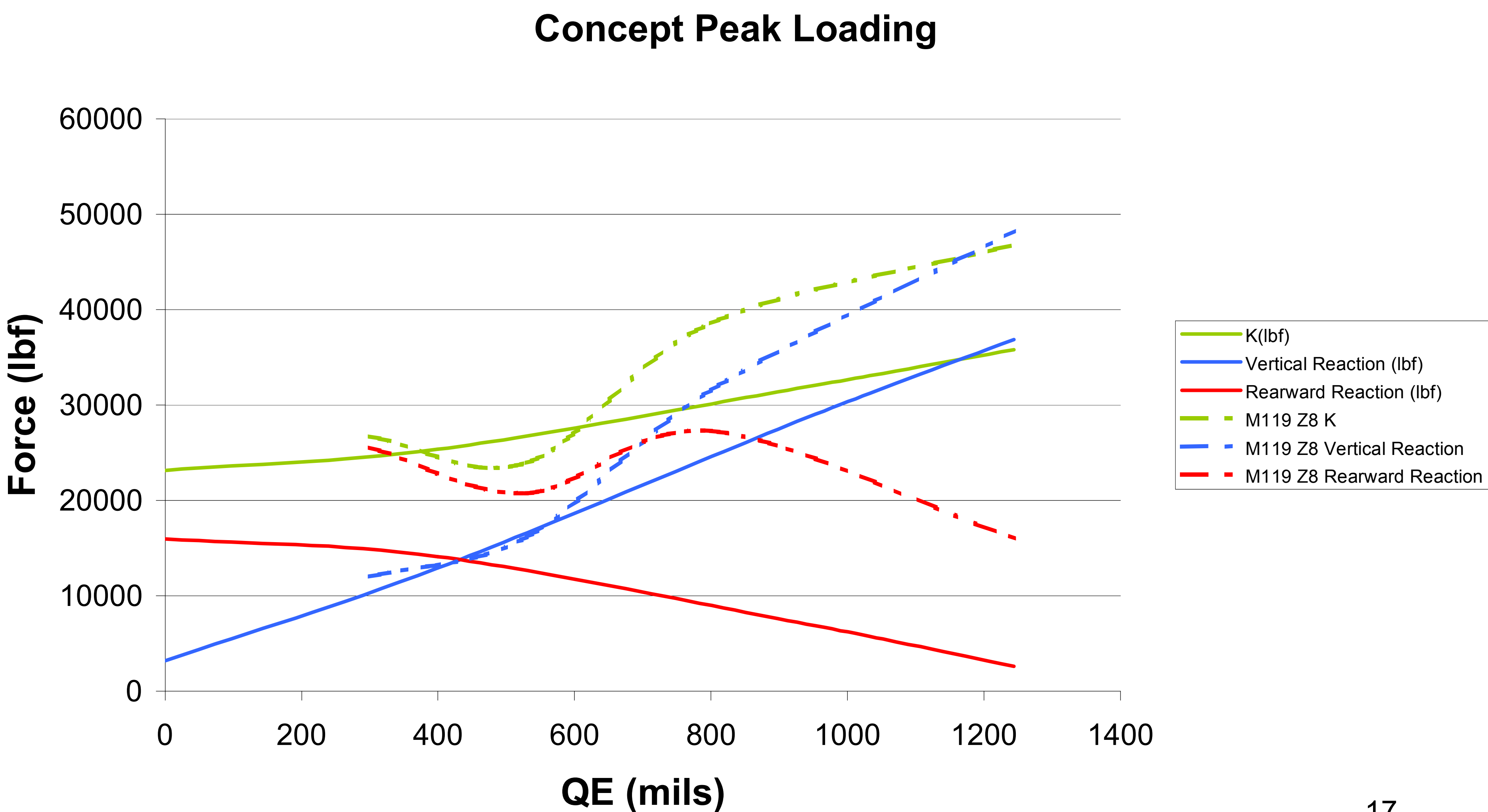
Concept System Characteristics

- Weight
  - Recoiling (primary) - 1710 lb.
  - Recoiling (secondary) - 915 lb.
  - System – 3230 lb.
- Max. rate of fire

  10 rounds per minute

- Ammunition – All compatible with M119A2 howitzer
- Range
  - M760 Ballistic-14.5km
  - M913 RAP Ballistic-21km
  - M913 RAP CCF-20km
- Recoil cycle time – 2.3 seconds

Concept System Dual Recoil



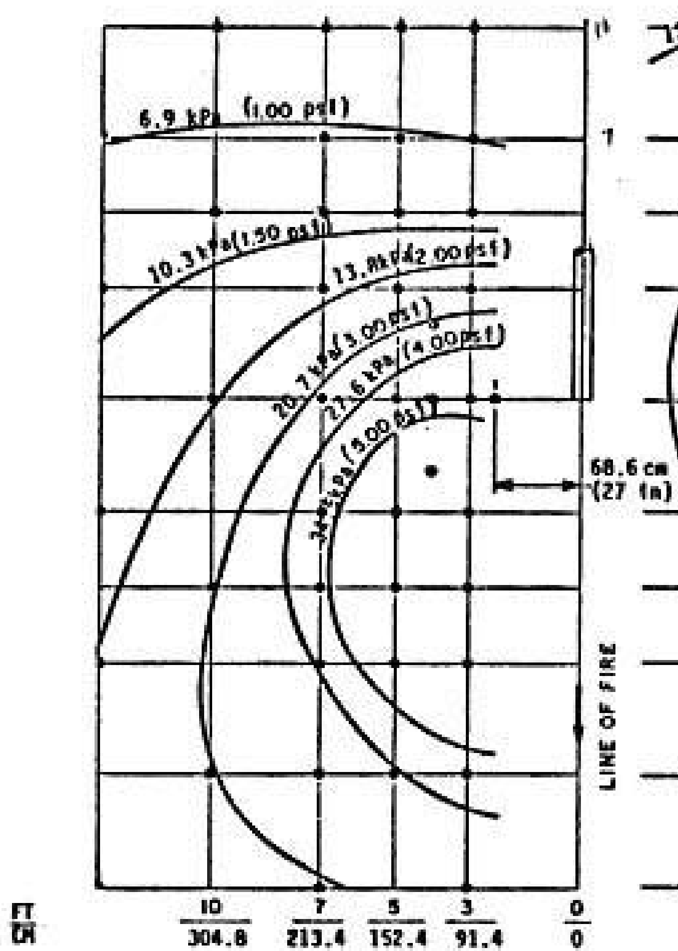
Dual Concept Compared to M119A2 Howitzer

Parameter	Concept	M119A2
System Weight (lb)	3230	4270
Max. Range - M760 (km)	14.5	14
Max. Range – M913 (km)	21	19.5
Max. Rate of Fire (rounds per minute)	10	8
Trail Configuration	Split	Wish bone
Muzzle Brake	None	Single Baffle, Med.
Peak Recoil Load, Primary @ 800 mils (lbf)	30000	38600
Peak Lateral Ground Reaction Load @ 0 mils (lbf)	16000	(22100 est.)

Dual Concept Compared to M119A2 Howitzer

Blast Overpressure

Dual Concept



M119A2